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QUARTERLY

OF THE

National Fire Protection Association

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National Fire Protection Association

INTERNATIONAL

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Reports of fires appearing in the Quarterly are copies of or extracts from written reports forwarded to the Association. This Association, as a body, is not responsible for the statements or opinions of any of its members.

The million dollar fire-resistive building is taxed to support public fire protection for the hundred dollar shack. Photograph by Geo. R. Hurd (Member N.F.P.A.), Jackson, Miss., Aug 25, 1937.

The Quarterly

Vol. 31 October, 1937 No. 2

Penalizing the Provident Taxation in general should be designed to cover the cost of services of benefit to the public as a whole, and it is obviously desirable that public expenditures should be for the benefit of the general public rather than for the private gain of any individual or interest. It is interesting to analyze taxation and public expenditures for fire protection on this basis. In the days when fire-resistive construction and automatic sprinkler protection were unknown and all the buildings in a city were of more or less combustible construction, fire protection was of substantially equal benefit to all and public expenditures for this purpose were very properly assessed on all property in proportion to its valuation. Nowadays when so many of the largest and highest valued buildings are of fire-resistive construction or have automatic sprinkler protection, public fire protection is not of equal benefit to all and in many cities a considerable proportion of fire department expense is solely for the protection of unsprinklered buildings of combustible construction, which have relatively low valuations and contribute only a small fraction of the total tax revenues. The photograph on the opposite page is a striking example. Under our present system of municipal taxation for fire protection, the greater part of the cost is borne by those who make the least demands upon the fire department. Is it too much to hope that some day the basis of this taxation will be revised so that public fire protection costs may be assessed not on the basis of total values, but on the basis of amount of combustible material subject to fire?

* * * * *

Progress in Fireworks Control Fires and deaths due to the promiscuous use of fireworks are among the most unnecessary of preventable fire losses. The N.F.P.A. has long advocated legislation restricting the use of fireworks to public displays under competent supervision, but it is only in recent years that substantial progress has been made in this direction. Owing to the ease of bootlegging, city ordinances are of limited value; state legislation is the only fully effective method of control.

There are now four states that prohibit the private use of fireworks: Michigan, Iowa, Kentucky and New Jersey. An account of the adoption of the New Jersey law appears in this QUARTERLY. The experience in New

Jersey indicates that this is one form of prohibition that has general public support. No parent wants to have his child exposed to the danger of death or mutilation by fireworks.

At the last annual meeting the N.F.P.A. Fire Marshals Section appointed a special committee to draft a model state law controlling the sale and handling of fireworks. Fire Marshal J. Vincent Pyle of Iowa is chairman. Following the horrible fireworks explosion in Nampa, Idaho (see page 110 of this QUARTERLY) public interest has been stimulated, and the Indiana Fire Chiefs Association, the Colorado State Firemen's Association, and the Montana State Firemens' Association have all passed resolutions calling for state legislation controlling fireworks. Ordinances controlling fireworks have been recently adopted in Atlanta, Georgia, Louisville, Kentucky, and Wheeling, West Virginia.

An interesting letter from our member H. F. Way of the Northwestern Mutuals Fire Association contains the following:

> "During the few days immediately preceding July 4, I distributed 2000 of the N.F.P.A. fireworks pamphlet in Sacramento, California. Unfortunately, a nine-year-old girl was almost burned to death from the use of fireworks. On the other hand, possibly it was a fortunate happening, for public opinion was so aroused that an ordinance prohibiting the sale and use of fireworks was passed through the city council on July 21. I feel certain that the distribution of your pamphlets along with the letters I wrote to the council helped to pass the ordinance."

* * * * *

The Gasoline Tank Truck Problem

One of the most troublesome problems now confronting fire protection authorities is that of the gasoline tank truck. In recent years, under the stimulus of improved highways, the highway transportation of flammable liquids has increased tremendously, with an attendant increased fire and explosion hazard. Added to the usual accident hazard of any form of highway transportation is the fire hazard of the flammable liquid in a moving tank with the chance that in case of any major accident to the vehicle the gasoline will escape and cause a fire which may take lives and spread to surrounding property.

Much of the hazard can be eliminated by the proper construction and maintenance of tank trucks. Where the N.F.P.A. recommended ordinance on this subject has been followed, as in New Jersey where state regulations are based upon the N.F.P.A. recommendations, the hazard is greatly reduced. Furthermore, gasoline trucks operated by the larger oil companies that appreciate the importance of fire safety measures have a relatively favorable fire record.

However, the fact remains that much gasoline is transported in substandard equipment and that some irresponsible individuals are in the gasoline transportation business. Even where the truck equipment is of proper type, a

difficult problem may be created where main highway routes pass through the congested districts of cities. The situation has been particularly acute in some of the middle western states, and some municipalities in Kansas have enacted local ordinances which are so strict as almost to prohibit the through transportation of gasoline in large trucks. An account of this situation was published in the July QUARTERLY, page 32.

Fire chiefs and other local authorities are asking why they should permit large gasoline tanks on wheels in the congested districts of their cities where stationary storage tanks are prohibited unless buried under ground. The North Carolina Fire Chiefs Association, for example, at their meeting at Greensboro on August 9, discussed this hazard and adopted a resolution calling upon the governing bodies of North Carolina municipalities to enact suitable ordinances on this hazard. This resolution was not designed to interfere any more than necessary with the legitimate business of gasoline transportation, which is obviously essential to the public convenience in these days of universal motor transportation. It was rather directed towards the control of avoidable hazards in connection with gasoline transportation, such as the parking of gasoline trucks in city streets where they are exposed to the danger of collision from other vehicles.

The problems involved in this situation are complex and it may be difficult to evolve a program for the maintenance of public safety without undue interference with the gasoline transportation business. It is, however, the established policy of the N.F.P.A. to recommend the solution of fire hazard problems in such a way as to safeguard the public without placing any unnecessary burden on the business or industry concerned. The N.F.P.A. Committee on Truck Transportation which now has this matter in hand will doubtless follow the established policies of the Association and evolve some satisfactory solution of the problem. The report of this committee at the next annual meeting of this Association will be awaited with much interest.

* * * * *

They Won't Tell

In former days when fire was universally accepted as an "act of God" there was little feeling of personal responsibility on the part of those concerned — little fear that they might have to answer for acts of omission or commission that were responsible for fire losses. It was therefore a relatively simple matter for the investigator to secure all the available information on the details of a fire, securing data of interest not only in respect to the particular fire in question, but pointing the way towards the prevention of future fire losses under similar conditions. But there is now beginning to be a public realization of the fact that most fires are due to someone's carelessness or negligence. Under such conditions the men concerned may be reluctant to give information which might reflect upon them personally. The situation is aggravated in the occasional case where there is

a question of legal liability — where persons who are injured bring suits for damages or where fires lead to other litigation of various kinds. In such instances a fire investigator may be considerably handicapped in securing the full story of a fire.

While it is regrettable that such influences prevent the obtaining of complete information on some major fires, we must recognize this tendency as a natural accompaniment of the increased public sense of responsibility for preventable fires, which has for many years been one of the important objectives of the Association. Fortunately in the great majority of instances our members who send fire reports to the N.F.P.A. office realize that the Association as such has no concern whatsoever with determining the personal responsibility for any particular fire, nor is it concerned with the specific liability for fire losses. The interest of the N.F.P.A. is purely of an engineering nature, a collection of the true facts of the fire which may be helpful to our members and the general public in studying possible fire effects under any given circumstances and in devising the most effective methods of fire prevention and fire protection. The N.F.P.A. Department of Fire Record, when requested to do so, considers the individual data submitted as confidential and follows the general policy of avoiding any participation in litigation on individual fire losses.

* * * * *

The 1937 Year Book Mailed as Part II of this QUARTERLY, the 1937 Year Book and Membership Directory gives an up-to-date record of the membership, committee personnel and other details of organization of the Association. The membership lists are this year arranged in a new form. Complete information as to the connections of associate members is given in the geographical section. It is hoped that the publication of the list in this form will be an added convenience to members and make it easier for each member to make contact with other N.F.P.A. members in the same locality and work together in matters of common interest.

Resistance to Building Innovations.

National Resources Committee Condemns Opposition to City Ordinances Calling for Fire Safe Construction

Condemnation of the conservatism of architects and the pressure of commercial interests in depriving us of improvements in building construction which would make for greater convenience and safety, was a highlight of a report made to President Roosevelt recently. The report is the work of the distinguished National Resources Committee, organized to take stock of present day affairs in the United States and to recommend a balanced national program. The present report is devoted to a consideration of technological improvements (changes in materials and methods) and their effect on employment and other factors in our economic community. The committee says about building trends:

"Architecture always has been conservative. When the early dwellers on the Alpine lakes descended into the Italian plains they continued to build pile dwellings, even when they settled on hilltops. It took 350 years and thirteen kings to eliminate inflammable straw roofs from Danish towns. In spite of their extreme combustibility and the inadequate protection from the cold they afforded and the easy availability of timber, which was cheaper and better, thatched cottages survived for a long period in the American colonies. Churches and public buildings still cling to the ancient and medieval forms.

"There was a long delay in using iron in building, and when it was used it was either hidden or, when unavoidably shown, employed with no idea of its esthetic possibilities. When Buffington took out patents for the steel frame skyscraper in 1888, the *Architectural News* predicted that the expansion and contraction of iron would crack all the plaster, eventually leaving only the shell.

Influence of Vested Interests.

"The pressure of vested interests has been a decisive factor in retarding change in housing materials. The lumber companies long fought legislation prohibiting the building of inflammable wooden buildings in large cities. Wooden shingle companies lobbied against laws for fireproof roofing. Brick manufacturers carried on a persistent campaign for years against concrete structures, predicting their collapse.

"Central heating systems have met stubborn and persistent opposition. In England, particularly, advances in heating methods have been widely ignored.

Technological Trends and National Policy, including the Social Implications of New Inventions, National Resources Committee, 1937. (400 pp., Government Printing Office, $1.) The material quoted above is from that part of the report dealing with Resistances to the Adoption of Technological Innovations in the Field of Building.

"Adequate toilet facilities, still regarded as incidental luxuries by many builders of homes for workers, were only slowly introduced into the homes of the middle-class late in the nineteenth century. Earlier, the bathroom was regarded as a superfluity in the Palace of Versailles, and the bathtub was removed and put in the garden for a fountain. There is ample evidence that the inhabitants of the palace acted in the spirit of Philip of Spain, who had authorized the destruction of all public baths left by the Moors on the grounds that washing the body was a heathen custom dangerous to believers.

Bathtub Denounced.

"In the 1840's the bathtub was denounced in the United States as an epicurean innovation from England designed to corrupt the democratic simplicity of the republic. The medical profession warned against it as a producer of rheumatic fevers, inflammatory lungs and zymotic diseases. Attempts were made to legislate against it. An ordinance prohibiting bathing between November 1 and March 15 failed of passage in the Philadelphia Common Council in 1843 by only two votes.

"When President Filmore installed a bathtub in the White House in 1851 there was an outcry against it as 'monarchial luxury,' which well could be dispensed with inasmuch as former Presidents had gotten along without them.

"Organized skilled workers in the building trades have slowed down the introduction of processes that threaten to endanger their health, destroy their skill, lower their wages and cause technological unemployment. Between 1911 and 1921, prohibitions against cutting, measuring and threading by machine of iron pipe of specific diameter were incorporated in agreements between plumbers' unions and builders' associations, and there were restrictions in regard to the use of substitutes for ferrules and brass soldering devices.

Prefabricated House Fought.

"When, recently, the mechanized industries, particularly in metal, entered the housing field with the production of prefabricated houses, they were met by the resistance of property holders, especially the banks, which held mortgages on about 58 per cent of 1933 value of all urban real estate, and which feared that an influx of cheap modern dwellings would subtract substantially from the market value of existing structures. These banks and loan companies have been unwilling to finance prefabricated houses except in rare exceptions, and then on a limited basis.

"Lumber companies and manufacturers of other materials which are being displaced in the production of prefabricated houses have sought to prevent their construction through building code restrictions and by organizing boycotts by dealers and building crafts.

"The director of the New England division of the American Institute of Architects in May, 1934, attacked prefabricated houses as tending to 'substitute a life of vagrancy for responsible citizenship in the community.' The author of an article entitled 'Houses Cannot Be Built Like Automobiles,' speaking in behalf of architects against prefabrication, argues plaintively, 'Spiritual, mental and physical well-being is enhanced always by the exercise and development of individualism, especially when related to the home and its environment. Housing that fails to respect these human values must be considered among the "chats" to be discarded.'

Public Housing Opposed.

"Planned public housing projects, such as slum-clearance, which afford the most efficient methods of utilizing advanced technologies in the building industry, crash against the wall of vested private-property interests. They meet the combined opposition of the owners of obsolete buildings that are still profitable, of landlords who demand prohibitive prices, of holders of mortgages who fear a depreciation of housing values through the increase in available homes.

"Achievements in building technology lie sterile in the face of the opposition of these interests. It has been calculated that at the rate of replacement between 1921 and 1933 of homes and apartments, the American house will be in use 142 years. Such slow replacement, based on profits derived from old houses, impedes the building of new structures, however pressing the housing needs for the mass of population in the United States may be."

Locomotives as Fire Engines.

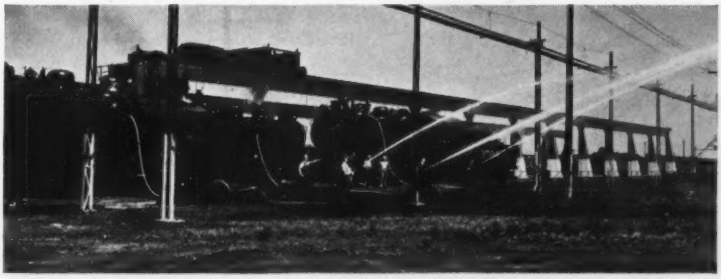
By G. R. Hurd,
(Member N.F.P.A.)

In recent years, various railroads throughout the country have equipped their locomotives with fire hose and connections to permit using their boiler feed injector pumps for fire fighting. This practice has provided valuable protection to freight and roadside property.

The quick availability of the engines over the entire length and breadth of freight yards increases their value by reducing exposure hazards to near-by buildings, standing freight cars and other concentrations of value.

Practice on the Illinois Central System.

The fire engine fleet of the Illinois Central System consists of 350 locomotives in service at terminals and other congested areas on the railroad. Quickly available in railway yards and at locations along the tracks, these



Fire fighting equipment on the locomotives of the Illinois Central System is inspected and tested periodically. Each locomotive is capable of supplying one hose stream for one hour.

Employees of the railroad testing their equipment on a bonfire in the railroad yards.

engines are expected to be an important factor in the reduction of fire hazards. No fire-plug is needed, as each locomotive carries its own supply of water. This adds to the speed with which, upon reaching a fire, it can get a stream of water into play.

Each locomotive carries a reel box containing fifty feet of specially treated cotton, rubber-lined hose, with a nozzle and necessary connection, all of which can be quickly attached. Normally the injector provides pressure for pumping water from the tender into the boiler, but when the fire fighting apparatus is in action most of the water is diverted into the fire hose.

A stream of water can be thrown sixty feet at the rate of 100 gallons a minute. The tender on each locomotive has a capacity of from 8000 to 10,000 gallons of water, so that under ordinary conditions the supply will last at least an hour.

Engine and train crews have learned how to handle the new equipment. Upon reaching a blaze these volunteer fire fighters remove the hose from the reel, attach it to the branch pipe from the pump and open the valve. A member of the engine crew directs the stream toward the fire. Fire hose and nozzles are kept in good condition, and there is regular inspection each month to make sure that the equipment will be ready for service when needed.

London Fire Brigade Headquarters—1937

The London Fire Brigade has this year become probably the best housed fire fighting establishment in the world. In the $1,945,000, nine story, fire-resistive headquarters that was opened July 21 on the Albert Embankment overlooking the Thames River, is a combination of many of the best British ideas of what a modern fire station should be. A far cry from the back rooms of the insurance company offices where the private firemen of 250 years ago waited for news of a fire in insured property, the new headquarters directs the operation of distributed equipment that can and does have apparatus at a fire in any part of London County in less than five minutes after the alarm.

The following information has been abstracted from a pamphlet of the London County Council entitled, "The Opening of the New Headquarters, London Fire Brigade, Albert Embankment, S.E. 1, by His Majesty the King, accompanied by Her Majesty the Queen. Wednesday, 21st July, 1937," supplemented by photographs and additional advices from Major C. C. B. Morris, Chief Officer of the London Fire Brigade (Member N.F.P.A.).

Arrangement of Buildings.

The site of the station consists of two main blocks stretching back from the Albert Embankment and the Thames. The huge administrative section, a light colored brick building except for a Portland stone section extending slightly above the ground floor, faces along 210 feet of roadway directly across the embankment to the river. Its main front has as decoration several large sculptured reliefs and, in the top story, a relief in stone and colored mosaic of the London County Council's Coat of Arms. Within the building is a memorial in bronze and marble to London firemen who lost their lives in performing their duty.

A one-story wing running back from the Thames at right angles is used as a museum where relics in the history of fire fighting together with examples of present practice in many parts of the world are on display.

Fronting toward the administrative building in the second block is the brigade training school with garage accommodation on the ground floor and lecture and residential quarters for the officers above. Extending from its rear are the brigade workshops. The remaining building in this block is on the other side of a railroad viaduct that passes back of the workshops and is part of an old "ragged school." It is now used as a band practice room.

Control Room.

On the second floor of the administrative building is the sound-proof nerve center of the entire London Fire Brigade. Most important in its equip-

Looking southeast from a boat on the Thames, the new headquarters of the London Fire Brigade resembles a large modern hotel. In the foreground is the "fire float" moored at its pier.

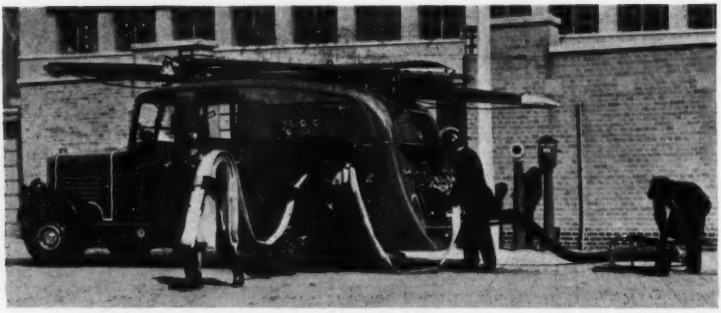
This old print shows the type of fire engines used by the London Fire Brigade in 1830.

ment is the main switchboard which occupies nearly an entire side of the room. It is direct connected in duplicate to the six "superintendent" London stations, a divisional station at Euston, the London Salvage Corps, Ambulance Headquarters, the County Hall, and other important allied services. Besides this it has six lines to the central telephone exchange. The wiring is accessible from the next room and is under the 24-hour-a-day supervision of a special lineman who is established there. If city electricity fails, the essential parts of the brigade activities can be operated by a self-contained emergency system.

On the wall of the control room is a large-scale map of the County on which, by means of colored pins, the movements of appliances from every station in London are constantly shown. This map facilitates the mobilization of apparatus at large fires while still maintaining protection at other parts of the city.

The Appliance Room.

The appliance room on the ground floor of the main building has seven run-outs to Albert Embankment. Housed there is the newest and very latest type apparatus of the brigade, for there its performance may be best watched by the senior officers. It consists of an enclosed pump, a turntable ladder, an emergency tender, a breakdown lorry, a hose lorry, a dual purpose appliance having both ladder and pump, and a canteen van. The turntable ladder incorporates many of the most modern safety and efficiency devices. There is



In the drill yard in the back of headquarters modern apparatus such as this is demonstrated to the public in weekly exhibitions. This is the latest type of enclosed pumper.

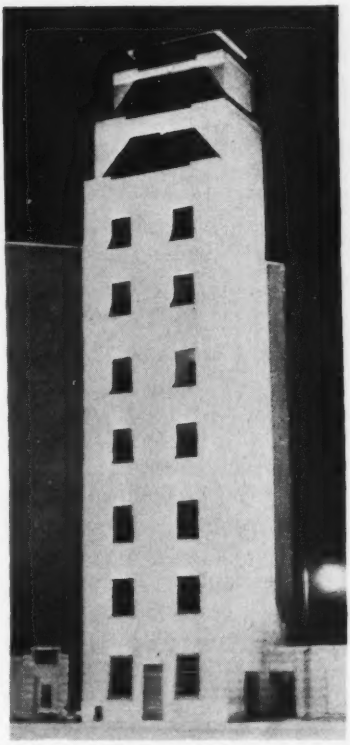
the automatic switch that stops the ladder-raising motor when the ladder has reached its maximum safe elevation at different degrees of inclination, and the built-in jacks that take the load off the pneumatic tires when the machine is at work. The breakdown lorry carries an exceedingly robust crane, not only for lifting fire-fighting equipment which may be disabled on the road, but for saving life by lifting overturned vehicles or other objects under which persons may be trapped. It also carries oxy-acetylene cutting equipment to cut away steel work which may have trapped persons. The canteen van is sent to large fires at which the men may need refreshment and food.

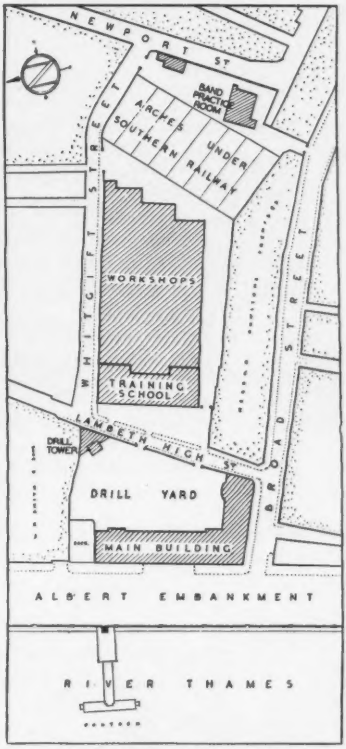
Directly across the Embankment is the brigade's pier, to which a fire boat is moored. The crew of the boat is accommodated in the main building during the night. On the pontoon is a watchroom in direct telephone communication with the main watchroom so that there may be no delay when the boat is ordered to a fire.

The alarm system throughout the building is extensive and efficient. When a call comes in it is relayed by the control room to an illuminated sign in the appliance room which indicates what pieces are to turn out. In case of a street alarm, the sign also tells the location of the box. A small scale, duplicate indicator is placed in each resident station officer's room and at other points throughout the building. This eliminates congestion at the sliding poles by which the men descend to the appliance room. From the control room, traffic signals at either end of the building are then operated to facilitate rapid turn-out. The radiator water in the lorries is kept warm by electric heaters so that there may be no delay in starting.

Brigade Accommodations.

There are 56 men besides officers constantly on duty at this station in a two platoon system. While at headquarters they are accommodated with lockers, mess rooms, etc., on the same floor as the control room. For recrea-





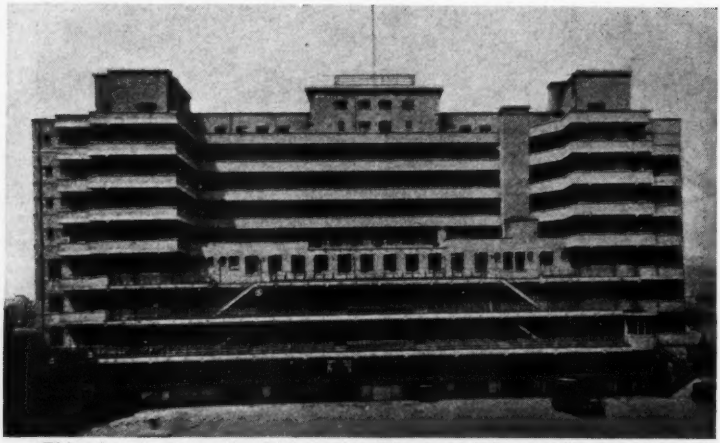
The nine-story drill tower can, as shown above, be floodlit at night. Setbacks on the topmost stories simulate terraces found in controlled buildings of this height. The tower is equipped with inside stairs and a 4 ft. standpipe. It is also used as a hose-drying tower. On the right is the ground plan of the entire new headquarters.

tion they have billiard tables and a boxing ring. The night shift is allowed to rest from 10:00 P.M. to 6:45 A.M. on bunks provided for the purpose.

The officers of the brigade have permanent residence in the five upper stories of the administration building. This part also houses officers of the Inspection Branch, and the Training School. The two stories directly above the control room are occupied by the administrative offices of the Brigade. On each floor is a balcony extending along the entire rear of the building.

Drill Yard.

The drill yard on which a weekly drill is open to the public is located directly in back of the headquarters, overlooked by the cascade of balconies. There are outside stairs to the bottom, three of these by which the public can climb to choice seats. Also used as a grandstand is the roof of the museum



This view is across the drill yard to the rear of the new headquarters. On the left is the museum, the roof of which supplements the three lower balconies as a grandstand. Note that the "run-outs" come completely through the building.

bounding one side of the yard. The main feature of the yard is a 100 ft. drill tower of brick equipped with an inside staircase and standpipe. The upper stories of the tower are set back to provide terraces in the manner required by the London County Council in controlled buildings of the same height. It is an ideal structure on which to practice both inside and outside hose and rescue work. Water for the drill and display is provided by three underground tanks and two hydrants on the premises.

The weekly public exhibition is accompanied by music of the brigade's own band, playing in a special band stand.

When not in use for drilling the tower is used for hose drying, for which purpose it is equipped with a drying hoist. It can be warmed artificially and there is an electric hoist for lifting wet hose to the top. In an adjoining hose testing plant, all new hose delivered to the brigade is tested to a pressure of 400 pounds per square inch.

Training School.

The training school in the second block is operated in conjunction with the actual practice in the drill yard. The headquarters of the school is used for lectures and motion pictures, giving theoretical knowledge. In the basement of the administrative building are sprinkler, drencher, and emulsion systems which may be operated on test fires. There is also a smoke chamber in which the firemen learn to use self-contained breathing apparatus under serious smoke and noxious gas conditions. Their practice is directed through windows in the side of the chamber. The room is entered by air locks. In case

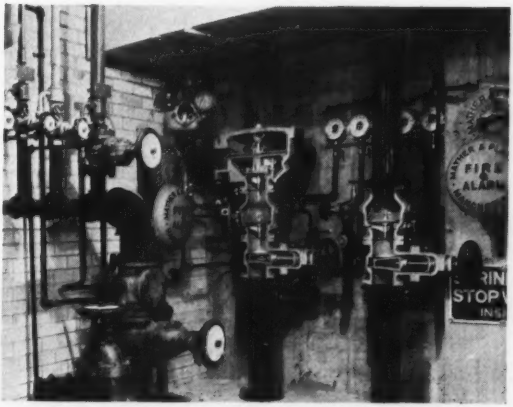
of emergency, there is an extraction fan which rapidly clears the smoke and gas from the room.

Workshop.

The London Fire Brigade undertakes to keep its equipment in first-class condition in the extensive workshops adjoining the rear of the Training School. It is elaborately equipped to examine and overhaul every piece of fire fighting apparatus, and does so at least once a year. Every three years the engines are taken down and completely overhauled. The minor work of oiling and cleaning the apparatus is done on a lifting ram in the appliance room of the main building.

The workshops also undertake the construction of all hook and extension ladders used in the brigade. They have a large store and supply room. Separate accommodation is provided for carpenters, blacksmiths and painters.

With this new home, the London Fire Brigade will continue with increased vigor its development of new and better technique in fire fighting. It replaces a long overcrowded station at a different site where for 51 years the brigade has upheld the best traditions of London fire fighting. One tradition, however, is on its way out. The historical shining brass helmet is being replaced with one of cork and rubber. "Owing, however, to the superior appearance of the brass helmets," says the London County Council, "they are being retained for ceremonial purposes."



As a part of the training school, a laboratory of fixed fire equipment is maintained in the basement of the main building. There is also much apparatus in working order that may be demonstrated on test fires.

New Jersey Prohibits Fireworks

On May 20, 1937, fire prevention in New Jersey won a signal victory. A state law prohibiting the sale, transportation and use of fireworks except for public display was on that day signed by Governor Hoffman and went into effect immediately. This was the result of ten years of constant agitation by civic organizations in all parts of the state. The victory was a great one, since it was accomplished in the face of the bitterest sort of lobbying by the many New Jersey fireworks manufacturers.

In 1930, New Jersey made a first attempt to control its dreadful life and property toll due to fireworks. (See QUARTERLY, Vol. 24, No. 2, p. 127.) The Department of Labor appointed a committee consisting of representatives from its own department, various police authorities and fireworks manufacturers. Experts on explosives were also present. An N.F.P.A. member, Gilbert E. Stecher of Weehawken, was on this committee to represent the Association.

The Department took this way of getting regulation of fireworks because it felt that it was virtually impossible at the time to secure the adoption of legislation for the complete removal of fireworks from the hands of laymen. Perhaps in the interim any sort of law would make the people fireworks conscious and have some result. Perhaps a campaign to induce the various municipalities to pass their own local ordinances against fireworks would eventually extend throughout the state. Therefore the department was content with the Haines Fireworks Regulations Act that ensued. The fireworks manufacturers were satisfied. The N.F.P.A. and its representative were not, and said so. It was clear to all interested in fire protection that a law which could do nothing but regulate the size of fireworks and the dates on which they could be sold could not do very much to reduce New Jersey's cases of blindness. But the department knew the strength of the fireworks lobby and was content to let further initiative come from some other source. The bill was passed readily by the legislature.

Fireworks Surveys Conducted.

During the following few years it became increasingly evident that but one thing had been accomplished. Under powers given it by the Haines Act the Department of Labor, Bureau of Explosives, was able to make thorough surveys of the fireworks situation. In the seven years, 1930 to 1936, their figures showed that New Jersey fireworks accidents had increased progressively from 498 to 927 annually. The local ordinance system had become an obvious farce. Fireworks bootlegging was so widespread that it was impossible to en-

force ordinances without charges of discrimination. Continually during this period advocates of fireworks prohibition tried to find a path to a good state law that could not be blocked by the lobby.

At last came a strong start; this time from the Hudson County Safety Council, and the Jersey City Chamber of Commerce. Assemblymen Bischoff and Pesin allied themselves with these two intelligent organizations and in an aggressive campaign they soon enlisted the support of every important civic organization in the state. A survey of fireworks accidents in the United States for the several preceding years had shown that only New York had a worse fireworks casualty record than New Jersey. This striking fact was spread over the front and editorial pages of most of the state's newspapers and public opinion soon reached a fever pitch. When the iron was sufficiently hot, a conference headed by George J. Baumann, Associate Counsel of the Jersey City Chamber of Commerce, and Frank J. Walsh, Managing Director of the Hudson County Safety Council, was called in Jersey City to discuss the advisability of a good state law on fireworks. Representatives of fireworks manufacturers were noticeably absent. The conference consisted of safety councils, chambers of commerce, representatives of insurance companies, and general insurance agents.

A tentative draft of a new act on fireworks prepared by Mr. Walsh was presented by the two assemblymen at that time. It was a prohibitive measure allowing only public displays under expert supervision. Carefully conceived to close all loopholes and be so reasonable that the manufacturers could not raise any justifiable argument against it, it was received by the committee with enthusiasm. On January 18, with only a few minor changes, it was dropped into the lap of the state assembly as the third measure of the session.

Immediately the fireworks manufacturers went to work, and, as had happened continually in previous years, managed to have the bill sent to The Miscellaneous Business Committee for consideration; really a pigeonhole where it would die harmlessly. In fact its chance of survival was considered so remote that the New York Journal of Commerce said drily, "The anti-fireworks measure in the New Jersey legislature has definitely received the undertaker's tag." Other editors were equally pessimistic. This time, however, public sentiment was aroused. The continued loyalty of the newspapers, plus the prodding of the legislators by the initiating committee, allowed assemblymen no peace until they suspended rules and brought the bill out again. It was passed by a 55 to 0 vote.

Passage Delayed in Senate.

The lobbyists delayed the bill in the senate for several weeks, but sentiment remained against them. They were able to accomplish finally only a minor change, a reduction in the bond required for public displays from $5,000 to $2,500, before the senate passed it. The assembly also passed the

unimportant change by unanimous vote and forwarded a final copy to Governor Hoffman's desk. On May 20, the affixment of the Governor's signature made this the law of New Jersey:

AN ACT concerning fireworks, regulating the sale, exposure for sale, use, distribution, or possession thereof, and providing penalties for violations of the provisions of this act.

BE IT ENACTED *by the Senate and General Assembly of the State of New Jersey*:

1. The sale, exposure for sale, use, distribution or possession of fireworks or pyrotechnics in the State of New Jersey, except as hereinafter provided, is hereby declared by the Legislature to be against the public health, safety and welfare of the people of the State of New Jersey.

2. From and after the passage of this act it shall be unlawful for any person, firm, partnership or corporation to offer for sale, expose for sale, sell, possess or use, or explode any blank cartridge, toy pistol, toy cannon, toy cane or toy gun in which explosives are used; the type of balloon which requires fire underneath to propel the same; firecrackers; torpedoes; skyrockets, roman candles, bombs, sparklers or other fireworks of like construction, or any fireworks containing any explosive or inflammable compound or any tablets or other device commonly used and sold as fireworks containing nitrates, chlorates, oxalates, sulphides of lead, barium, antimony, arsenic, mercury, nitroglycerine, phosphorus or any compound containing any of the same or other explosives, or any substance or combination of substances, or article prepared for the purpose of producing a visible or an audible effect by combustion, explosion, deflagration or detonation, except as in this act provided.

3. The governing body of any municipality, other than a county, notwithstanding any of the provisions of this act to the contrary, may, upon application in writing, upon the posting of a suitable bond, grant a permit for the public display of fireworks by municipalities, religious or civic organizations, fair associations, amusement parks, or other organizations or groups of individuals, approved by the governing body of such municipality to whom the application is made, and the governing body is authorized by resolution, to grant such permission when such display is to be handled by a competent operator, to be approved by the chiefs of the police and fire departments of the municipality. Such display shall be of such a character, and so located, discharged, or fired, as in the opinion of the chiefs of the police and fire departments, after proper inspection, shall not be hazardous to property or endanger any person or persons. After such permit shall have been granted, sales, possession, use and distribution of fireworks for such display shall be lawful for that purpose only.

4. All such applications for permits shall set forth the date, the hour, place of making such display, and place of storing fireworks prior to the display and, further, the name or names of the person, persons, firm, partnership, corporation, association or group of individuals making the display; the name of the person, or persons, in charge of the igniting, firing, setting-off, exploding or causing to be exploded such fireworks. The location of the storage place shall be subject to the approval of the chief of the fire deparment of the municipality. No permit granted hereunder shall be transferable.

5. The governing body of the municipality shall require a bond deemed adequate by the municipality from the licensee in a sum not less than twenty-five hundred dollars ($2,500.00) conditioned for the payment of all damages, which may be caused either to a person or persons or to property, by reason of the display so as aforesaid licensed, and arising from any acts of the licensee, his agents, employees or subcontractors. Such bond

shall run to the municipality in which the license is granted, and shall be for the use and benefit of any person, persons, or the owner or owners of any property so damaged, who is or are authorized to maintain an action thereon, or his or their heirs, executors, administrators, successors or assigns.

6. Nothing in this act contained shall be construed to interfere with the provisions of an act entitled "An act to regulate the manufacture, storage, transportation and sale of fireworks and providing penalties for all violations of this act," approved March twenty-five, one thousand nine hundred and thirty, and the acts amendatory thereof and supplemental thereto, where the provisions thereof are not inconsistent with the provisions of this act, nor shall anything in this act contained be construed to prohibit any manufacturer, wholesaler, dealer or jobber from selling at wholesale such fireworks to municipalities, religious or civic organizations, fair associations, amusement parks, or other organizations or groups of individuals authorized to possess and use fireworks under this act; or the sale of any kind of fireworks, provided the same are to be shipped directly out of the State; or the sale or use of blank cartridges for a show or theatre, or for signal purposes in athletic sports, or by railroads for signal purposes, or for the use by the militia. Any provision of any act in this State inconsistent with any provision of this act is hereby repealed.

7. Any person, firm, partnership, or corporation violating any of the provisions of this act shall be subject to a penalty: For selling, offering or exposing for sale, or having in possession with intent to sell any fireworks as herein mentioned, the sum of one hundred dollars ($100.00) for each offense, or by imprisonment in the county jail for a period of ninety days, or by both such fine and imprisonment in the discretion of the court having jurisdiction and for using, discharging or causing to be discharged, ignited, fired, or otherwise set in action, or having in possession any fireworks, a sum not exceeding one hundred dollars ($100.00) for each offense.

8. The municipalities of this State are hereby charged with the enforcement of all of the provisions of this act.

9. This act shall take effect immediately.

Here the fight was thought to be over, but there still remained one or two sputters in the manufacturers. A week after the bill was made law, the Trenton Fireworks Co. obtained a court order directing Prosecutor Duch and Police Chief Forest of Ewing, N. J., to appear in Trenton Court and show cause why they should not be restrained from enforcing it. The injunction was promptly denied by the court. The court said that the act is "for the advancement of health and welfare of the people" and that the regulation of sale and possession of fireworks is "perfectly within the police powers of the state." Another attempt at obtaining an injunction, this time on the charge of confiscatory action by the legislature, was dismissed by the court with the opinion that New Jersey manufacturers had ample time to dispose of their stocks, before adoption of the law. One last action was brought in the Court of Chancery, Newark, but in it, too, after a stirring and able defense by Counsel Charles Hershenstein the new act was curtly upheld.

Looking back at the Fourth of July period for 1937 the tremendous success of the act, even in its first year, is evident. As a result of enthusiastic

public coöperation, the state enjoyed a quiet holiday that exceeded even the most optimistic hopes of the proponents of the law. Fireworks accidents were almost entirely eliminated. The total number of accidents for the state was 36, each of them classed as minor. Not a cent of property loss resulted from fireworks. A typical example is the city of Newark in which only four casualties were reported. In 1936 there had been a total of two hundred; this from the state's largest city. Commissioner of Labor Toohey said, "It would be impossible to compute the actual value of this legislation to the people of New Jersey in dollars and cents."

Fireworks Explosion, Nampa, Idaho.

By Idaho Surveying and Rating Bureau,
(Member N.F.P.A.)

Six people (including two children) killed, twelve others more or less seriously injured and property damage estimated at about $10,000 are results of the explosion of a retail stock of fireworks in a Nampa, Idaho, drug store on the afternoon of July 1. The monetary loss was mostly caused by damage to stock and to furniture and fixtures, the damage to the building being placed at only about $2000. As might be expected, the tragedy was consummated in one short, intense concentration of heat, noxious gases and panic. Such information as could be obtained seemed to indicate that several minutes elapsed between the ignition of the stock of fireworks and the transmission of the alarm to the fire department. However, in view of the nature of the disaster, it is not likely that the delay was a contributing factor. Fire Chief Lessinger reports that the time from the arrival of the fire department until the fire was practically extinguished and the two large pumpers were disconnected was not more than fifteen minutes. It was, he said, the most rapid fire and the most merciless extinction of human life he had ever seen during many years of fire fighting.

Construction and Occupancy.

The occupancy in which the explosion and fire occurred was a drug store in a one-story structure of ordinary wood-joisted brick and concrete construction. The dimensions of the building are 90 x 120 feet, and interior partitions are plastered on a mineral-base on wooden studding wall-board. In spite of the intense heat, only minor spalling of the plaster occurred, even on the ceiling directly over the point of highest temperature. The occupancy of the building is omnibus mercantile, and includes, besides the drug store, a variety store and a retail furniture store. The drug store had a frontage of 22 feet and a depth of 120 feet. Over about the rear third of the ground floor is a mezzanine floor, which was occupied by a beauty parlor and beautician school.

The front of the drug store at the moment when the fire was finally extinguished. The fireworks being near the door, this end was most seriously damaged.

Access to the main floor from the mezzanine is by way of one narrow stairway, and the only other means of leaving this floor is through four windows in the rear wall of the building — each about 2 x 2½ feet. These windows were glazed with ordinary glass in wooden sash, and their sills are about 15 feet above the ground.

The stock in the drug store besides the fireworks was usual for the class, and included, it was reported, a fair amount of articles manufactured from pyroxylin plastic. In the beautician school on the mezzanine was considerable equipment common to beauty parlors, none of which contributed to the disaster in any way. The stock of fireworks directly responsible for the tragedy is said to have been of fairly good size, and was located just to the right of the front entrance inside the drug store.

There appears, therefore, to have been nothing about the entire arrangement that cannot be found substantially duplicated in thousands of mercantile establishments over the United States during the first few days of July.

Story of the Fire.

The tragedy occurred during the height of the afternoon shopping period, while the store and beauty shop were crowded with customers. It may never

be known with certainty by whom or how the spark was supplied; but from a mass of largely contradictory testimony the most logical assumption is that a child entered the store — probably to replenish his supply of firecrackers — with a piece of lighted "punk" in his hand. Two young sons of the proprietor of the drug store were in attendance at the fireworks stand.

It is evident that the initial explosions were in progress before anyone took any particular notice of the situation. The appearance of the store after the fire indicates that there was an intense concentration of heat at the front of the store, which rapidly flowed to the rear along the upper part of the room space. It seems probable that owing to the suddenness of the blast, the rapidity with which the fire spread and the panic that ensued, several minutes passed before anyone thought to send an alarm to the fire department. The alarm was received at exactly 4:30 P.M. The fire station is located approximately four blocks from the drug store; and witnesses state that in an incredibly short time after they heard the siren on the station tower, the fire department arrived at the scene. The apparatus responding to the alarm consisted of one triple combination pumper, hose and chemical, one quadruple combination pumper, hose, ladder and chemical, and one light truck equipped with a small pump and water tank. A total of 5 paid men responded with the apparatus and 6 more responded immediately from their homes. These were reinforced within a very few minutes by 7 call men. Although six lines of hose were laid, and the fire practically extinguished within a few minutes, water was used judiciously. After the fire, the premises showed almost no damage beyond that caused by the fire.

The intensity of the heat at the front part of the store was such that pieces of the plate glass panel of the front door were partially melted and curled and twisted into various shapes. Lenses in some of the cameras on shelves near the front were partially melted. The stock on the shelves back of the front half of the store, however, was practically undamaged for a height of four or five feet above the floor. The appearance of woodwork and equipment on the mezzanine seems to indicate that no actual flame reached there. Neither on the inside walls and ceiling nor over the windows outside is there any pronounced "smoked-up" appearance, indicating that whatever sooty smoke may have been generated from burning wood and paper was completely consumed in the intense heat from other combustibles.

Loss of Life and Rescue Work.

Considering the relatively small property damage, the loss of life in this fire was the outstanding feature. At the time of writing, the number of dead totals six; and the number of injured, twelve. The greatest number of those who lost their lives were on the mezzanine when the fire started. It is not known whether any attempted to go down the narrow stairway to the main floor, although the body of one little girl was found at the bottom of the stairs

Before the ladders to the two-foot by two and one-half-foot windows were supplied, customers trapped in the mezzanine beauty parlor at the rear of the drug store were forced to jump the fifteen feet to the ground. Note the dislodged meter box, right, which one woman used as a halfway support.

after the fire was out. By far the larger number of those in the beauty shop escaped, with and without assistance, through the small windows in the rear. At least one woman, however, was evidently attacked so suddenly by the heat and gases that she hardly moved from where she was sitting. This woman died almost immediately, due, no doubt, to the wave of heat and gases that swept into the mezzanine in a matter of seconds after the first explosion. The little girl found at the bottom of the stairs was evidently on the mezzanine, and either ran or fell down the stairs to the main floor. It was probably this transfer to comparatively cooler air that prolonged her life for three hours after the fire. It is believed the other child victim was near the front of the store, and that trampling may have been partly responsible for her death. These three were all dead three hours after the fire; three others succumbed the following day.

When the first explosion occurred, persons on the ground floor rushed toward the rear door. It is reported that this was stuck and could not be opened for a moment; it finally yielded, however, and most of those on the ground floor escaped that way. On the balcony there was only one avenue of escape open, the rear windows. A number jumped to the concrete pavement below, resulting in some severe injuries. One woman had the presence of mind to step on to a meter-box on the rear wall before jumping the rest of the way.

The meter-box tore loose, but broke her fall. After the first few had jumped, onlookers who had gone to the rear of the building began trying to catch those following. By the time the fire department arrived, most of those still able to move had left the building. One member of the fire department performed heroic work in bringing out four inert forms through these windows, and collapsed while attempting to get a fifth. He suffered severe burns and gas irritation, but is now recovering. It was said that a full hour after the fire was out, it was still unbearably hot on the mezzanine.

Conclusions.

There is nothing to be said about this fire that has not been repeated time and time again: That the sale of fireworks to the public — especially when displayed in an enclosure — is a practice that is always fraught with acute danger, and one that should be prohibited throughout the United States. It should be apparent, also, that the placing of the display right at the front entrance of the store was a flagrant violation of good judgment. Such a procedure would most naturally render this means of exit impassable at the very time when it was most urgent that it be open. Another point of dangerous procedure appears to be the intrusting of stock of this nature to immature help who, naturally, would be less watchful, and appreciate the hazards of the display less, than the average adult. Only about four years ago, the city of Nampa repealed an ordinance prohibiting the sale of fireworks within the city limits, due to pressure brought to bear by certain mercenary interests. It is also significant of the influence exerted by some who put profit above safety, that in June, 1934, an ordinance was passed putting certain restrictions on the discharge of fireworks within the main business district, and about a year later, this ordinance was amended in such a way as to remove its effectiveness. Immediately after this latest fire, the mayor issued a proclamation prohibiting any further sale of fireworks; but within a few hours the proclamation was withdrawn, due, it is reported, to the insistence of certain merchants who had large stocks on hand that the ordinance of 1935 specifically gave them permission to sell fireworks. The mayor and council were forced to act against their desire in withdrawing the proclamation.

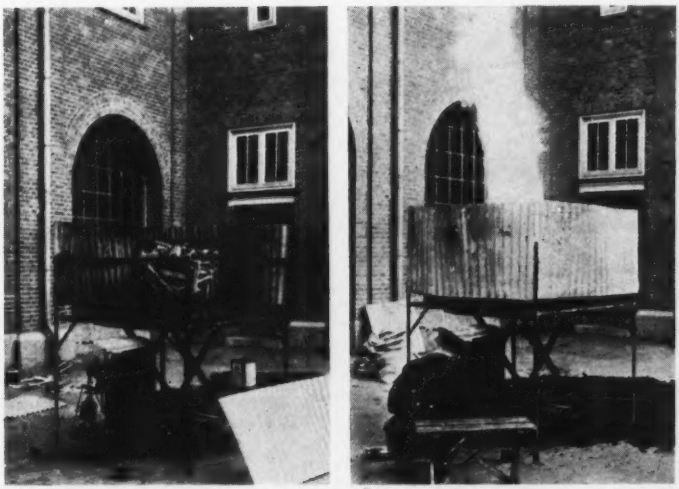
Experiments in Fire Extinguishment.

By Chief Officer F. Folk,
Fredericksberg, Denmark, Fire Brigade.

In various countries much progress has been made in comparing and classifying building materials and structures with regard to their power of withstanding the action of flames. But it is only in recent years that the effect of various means or methods that can be used for extinguishing fires has been investigated. In 1931, I and my co-workers, Brigade Officer Mr. J. Mygind and Mr. H. Adeler, B. Sc. Chem Eng., worked out a method of making such an investigation through progressive experiments on burning wood.

The Course of Combustion.

For these experiments it was necessary to duplicate actual fire conditions. The subject for experiment had, therefore, to be a pile or stack of sticks, burning under natural draught, and not a single test-body. After some introductory experiments, air-dried fir sticks, 15 x 2½ x 2½ cm. (6 x 1 x 1 in.*) in a pile weighing 40 kg. (88 lbs.) were selected for the test. The sticks were placed in a cylindrical wire basket, mounted on a scale, and shielded from the wind, and the entire bottom of the pile ignited at once by a basin of burn-



Preliminary experiments on the course of combustion were made with a basket full of sticks placed on an outside scale. These were shielded from the wind and ignited by a pan of gasoline.

*All English units approximate.

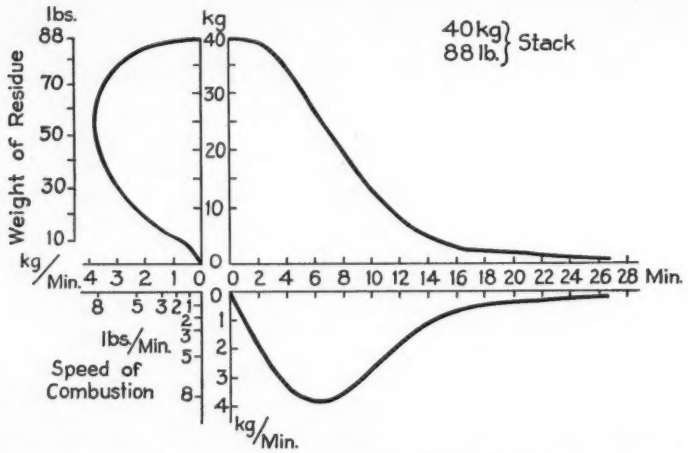


Fig. 1. Normal combustion curves. The curve at the upper right shows the progressive decrease in weight as the pile burns. The other curves show the rate of combustion.

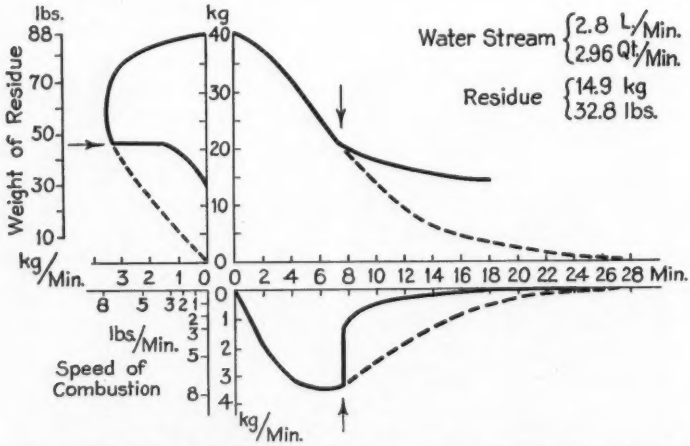


Fig. 2. Effect of extinguishment. These curves are similar to those in Fig. 1, with water applied at the point shown by the arrows.

ing gasoline. Measurements were made during the combustion by noting how long it took for the balance to right itself after removing a certain weight from the scale. The normal combustion graph, illustrating how the speed of combustion varies with the time and the diminishing weight of the pile (Fig. 1) was determined from numerous experiments performed in this way.

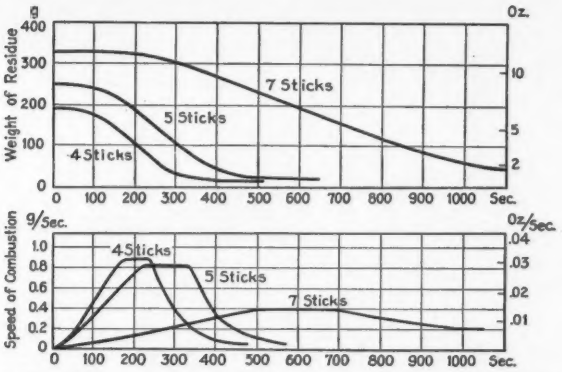


Fig. 3. Combustion curves of ten layer piles having four, five, and seven sticks per layer.

These observations having been made, we proceeded to investigate the effect of application of water. Although this effect was shown graphically (Fig. 2), it was difficult to express the results in figures. Finally it was decided to use the weight of the residue of the pile saved by extinguishment as an index of performance.

From this point, we made more accurate and smaller scale experiments in the laboratory. A weighed test body was placed upon a well-protected laboratory balance. The pile was so stacked as to assure a proper basis for comparison and to obtain good conditions for the action of the extinguisher. After experimenting, a pile built crosswise was decided upon.

With stacks so arranged, renewed investigations were made of the course of combustion. It then appeared that, because of the short duration of the laboratory experiments and the small number of the wood sticks, it was necessary to work with wood which had not only the same moisture content, but which was also sorted according to specific gravity, a factor that was found to vary widely. A cross-pile built of sticks 10 x 1 x 1 cm. (4 x 4 x 4 in.) in dimension was first used. Fig. 3 shows the graphs of the combustion and its rapidity for three such piles, each consisting of 10 layers and having respectively 4, 5, and 7 pieces per layer. The curves, therefore, show to what degree the course of combustion depends upon the admission of air. They differ from those in the large scale experiment (Fig. 1) in that they show a marked straight section in the combustion graph and a corresponding horizontal section in the rapidity graph. This is due to the optimum shape of the pile and the more exact observation in the laboratory experiments.

The laboratory experiments show clearly how combustion proceeds in three characteristic stages: The ignition stage, in which the fire spreads itself in a degree that is characteristic for the combustible object chosen; the stage of gas combustion, which travels upwards through the pile like a zone of fire,

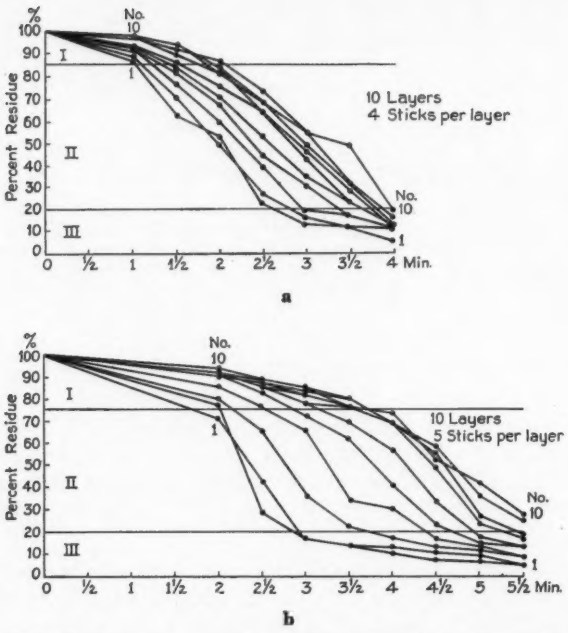
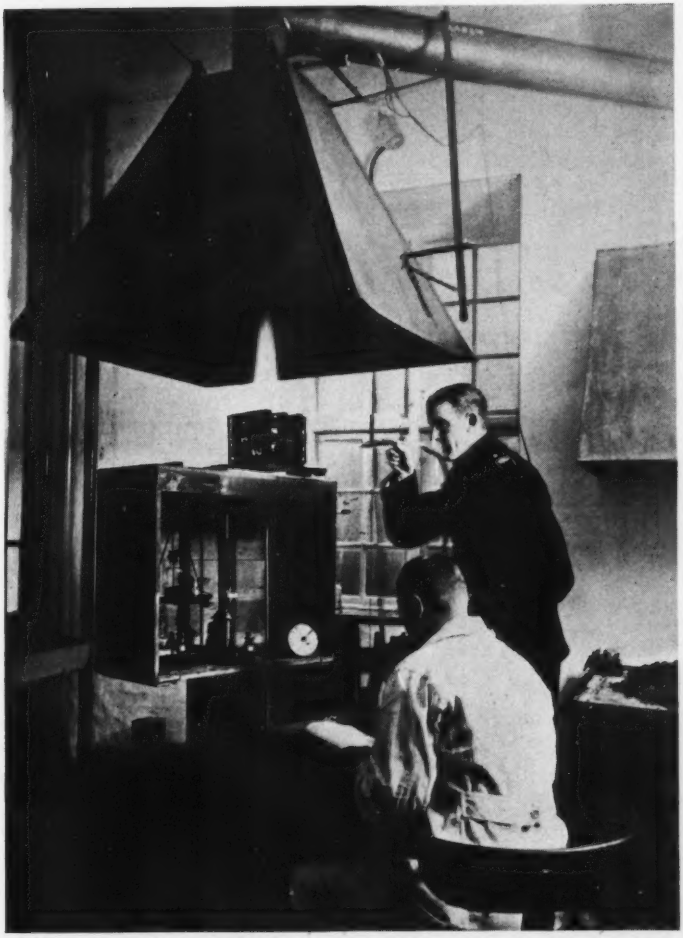


Fig. 4. Combustion curves per layer of piles having ten layers of four and five sticks per layer.

giving heat to the overlying layer, which is thereby ripened to be gasified; and the stage of glow into which the charred underlying layers pass. By means of a "deterrent experiment" in which the process is suddenly stopped by placing a metal box over the pile, it is possible by weighing one layer after another to show how each of the layers in a series gradually passes through a process the graphs of which are similar to those for the whole pile. These stages of combustion are shown by Sections I, II, and III, in Figs. 4a and 4b for piles having layers of 4 and 5 pieces respectively. Section I represents the ignition or ripening stage, Section II, the flame stage and Section III the glowing stage. From these experiments it can be seen that the compass of the fire zone and the speed with which it spreads is largely determined by the admission of air.

Extinguishment.

As the effect of extinguishing streams depends upon the stage of combustion in the stack (whether it is being ignited, gasified, or is glowing) and all these stages are normally co-existent in the burning object, it is difficult to obtain distinctive results. When a stream strikes a stick which is in the ripen-



The equipment used in these experiments for weighing burning test piles in the laboratory and recording the effect of extinguishment.

ing stage, it can easily stop the process and "save" the stick. On the other hand, there must be a far greater use of water with less result to extinguish the glowing remainder of the charred stick. Thus it may be seen that when it is not possible to extinguish the fire at once, the chief object should be to prevent the advance of the fire zone.

For experiments in extinguishment a stack of 6 layers, each consisting of three cross-laid pieces 15 x 2.5 x 2.5 cm. (6 x 1 x 1 in.) in dimension, was

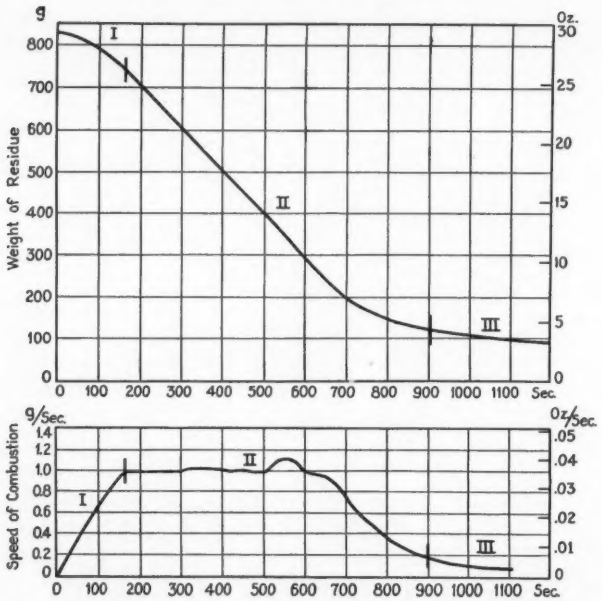


Fig. 5. Combustion curves of six layer pile, three sticks per layer. Portion of curve marked I is ignition stage; II is combustion stage; III is glowing charcoal stage.

chosen. It was found that in this stack the conditions of admission of air are so favorable that the whole stack is set on fire almost immediately after ignition. Fig. 5 shows the combustion graphs for such a pile. The peculiar lump toward the end of the rapidity curve — when the fire blazes up with bright flames—is indicative of the fact that the gas and air are in optimum proportion at the end of the gasifying period. Fig. 6 shows how the layers in this pile burn all at the same time almost in the same way, and therefore all represent the same stage. Such a combustion can be regarded as a part of a larger one.

The extinguishing nozzles were produced by drawing a glass tube to a point, breaking it, and filing it to get a bore of proper size. In this way excellent small streams having a water flow of from 4 to 40 cu. cm. (.25 to 2.5 cu. in.) per minute were obtained. The pressure was regulated by leading the water through a rubber tube from a flask reservoir which could be raised or lowered. In the laboratory the extinguishment was done in three different combustion stages, i.e.,with a weight of residue of respectively 75, 50 and 25 per cent of the original weight. The experiments were performed with a water pressure of .75, 2.00, and 7.25 mtr. (2½, 6½, and 24 ft.) head of water. In the large scale experiments all the extinguishments were performed with the

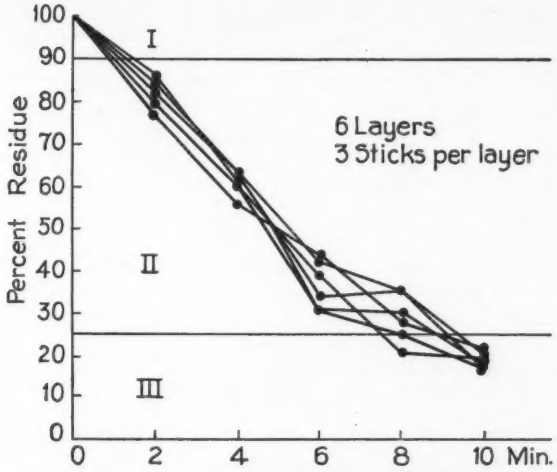


Fig. 6. Combustion curves per layer of pile having six layers of three sticks each, showing how for this pile layers burn in the same way at the same time.

pile burned down to 50 per cent of the original weight and with a water head of 4, 20, and 80 mtr. (13, 66, and 262 ft.).

With this experimental background the three chief factors in fire extinguishment: (1) the stage of combustion, (2) the size of the stream, and (3) the water pressure of the stream, can be considered.

1. The Combustion Stage.

The comparison of three experiments given in Table 1 leaves no doubt of the importance of applying the water quickly in order to obtain the greatest possible residue with the least possible use of water. The rapidity of combustion in the pile which had been burnt down to 630 grams (1.4 lbs.) was 1.0 grams per sec. (.04 oz. per sec.). This corresponds to about 3.0 kg. cal. per sec. (12 B.T.U. per sec.) heat evolution. A stream of 8.5 cu. cm. per min. (.52 cu. in. per min.) corresponding to an evaporative heat of only .085 kg. cal. per sec. (.34 B.T.U. per sec.) extinguished the fire after 152 sec. Therefore the generally accepted belief that the evaporative heat of a properly measured water stream must be equal to the heat that is developed during a fire is shown to be false. The object of the extinguishment is to reduce the temperature of the fire to such a point that combustion ceases, and the cooling necessary for this purpose is determined by the heat *content* and not by the heat *evolution*. The heat content is found in the glowing charcoal, while the greater part of the heat evolution is in the gaseous products of combustion. The power of a fire to resist extinguishment is therefore mainly determined by the amount of charcoal. This increases during the gas combustion and thereafter glows away.

Table I.

These experiments were made on stacks weighing 840 grams. The pressure on the water stream was a head of two meters.

Test No.	1	2	3
Per cent of residue when water was applied	75	50	25
Weight of stack in grams when water was applied	630	420	210
Rapidity of combustion in grams per second	1.0	1.0	0.9
Size of stream in cubic centimeters per minute	8.5	26	21
Time required for extinguishment in seconds	152	120	236
Total water used in cubic centimeters	22	52	83
Residue saved, in grams	556	360	157
Per cent of stack saved	66	43	19
Per cent of stack at start of extinguishment saved	88	86	75
Residue per centimeter of water used in grams	25.3	6.9	1.89
Approximate heat evolution in kilogram calories per second	3.0	3.0	2.7
Evaporative heat of stream in kilogram calories per second	0.085	0.26	0.21

There is consequently little difference in the resistance offered by a pile 50 or 25 per cent of its original weight.

In "Feuerschutz" No. 2 of 1925, Engineer Stanzig, Vienna, estimated that .5 liter of water per kilogram (.24 qt. per lb.) was required for the extinction of charcoal. In our experiments we found that in the case of a pile burnt down to 25 per cent, where nearly the whole of the residue of 172 grams (.379 lb.) was charcoal, extinguishment was accomplished with 66 gm. (.146 lb.) of water, or .4 liter per kilogram (.19 qt. per lb.) of charcoal.

2. Flow of Water in the Jet.

By experiment it can be shown how the residues of the pile grow in proportion to the size of the stream, but, according to Fig. 7, this applies only up to a certain point. At this point a small increase in supply of water brings about a multiplication of the residue. This is particularly noticeable where the piles are 75 per cent the original weight.

It will be seen that the jump takes place in the case of the 630 gm. (1.4 lb.) piles with a water supply of about 8 cu. cm. per min. (.49 cu. in. per min.) and in the 420 gm. (.93 lb.) piles at about 18 cu. cm. per min. (1.1 cu. in. per min.). It could not be determined exactly whether any jump took place in the 210 gm. (.46 lb.) piles. The graphs Fig. 7, a, b, and c, show how the course of extinguishment differs on opposite sides of the jump. From these it can be seen that in the case of piles not too far burnt there are superior streams which cause extinguishment rapidly, and inferior streams which are able to extinguish only a part of the fire and keep it protected against ignition until so much of the pile has burned that the stream becomes superior. The extinguishment can then proceed until the whole fire is put out. It is remarkable that the difference between such superior and inferior streams is so small. In practice, the important lesson is, that the stream should be directed only

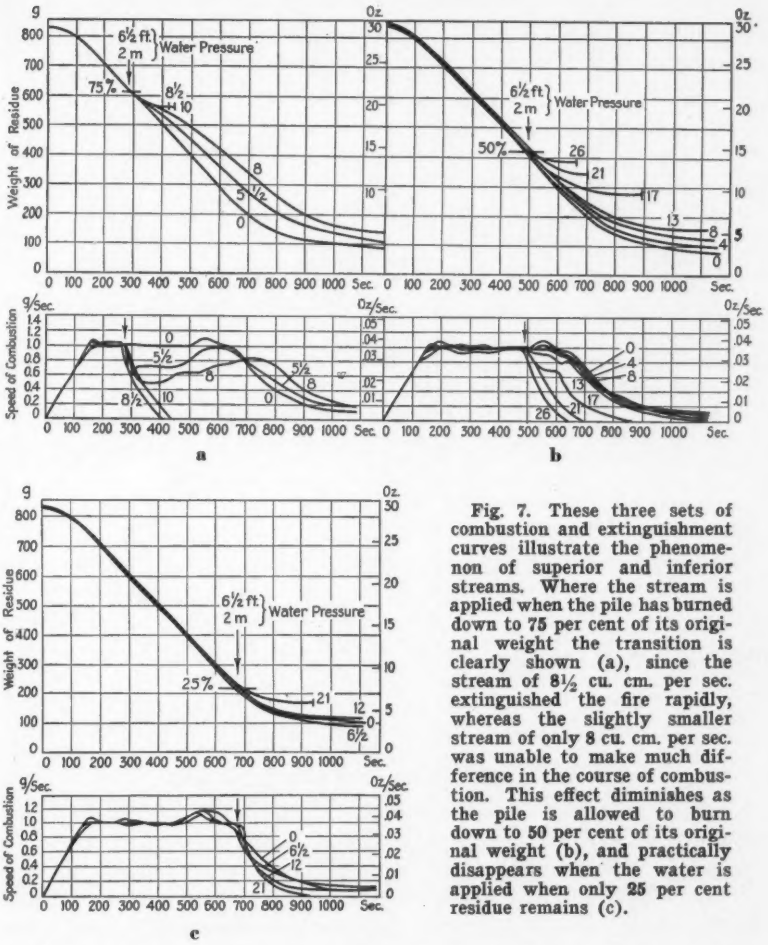


Fig. 7. These three sets of combustion and extinguishment curves illustrate the phenomenon of superior and inferior streams. Where the stream is applied when the pile has burned down to 75 per cent of its original weight the transition is clearly shown (a), since the stream of 8½ cu. cm. per sec. extinguished the fire rapidly, whereas the slightly smaller stream of only 8 cu. cm. per sec. was unable to make much difference in the course of combustion. This effect diminishes as the pile is allowed to burn down to 50 per cent of its original weight (b), and practically disappears when the water is applied when only 25 per cent residue remains (c).

where it is superior in order to get the greatest possible effect of it without wasting the water or causing it to be evaporated to little purpose.

3. The Water Pressure of the Stream.

Besides the view that the evaporative heat of an appropriate stream of water must correspond to the heat developed by the fire, it is often maintained that an increase of the force with which the water meets the burning object will increase the extinguishing power due largely to the greater penetration power in the charcoal. In an address at the Fire Prevention Congress at Paris in 1934, Captain Foussoult took objection to this view as being contrary to his

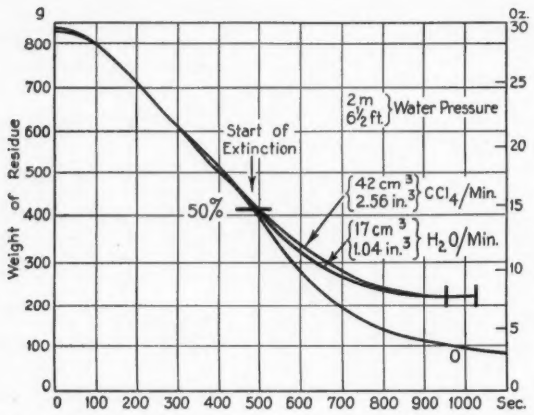
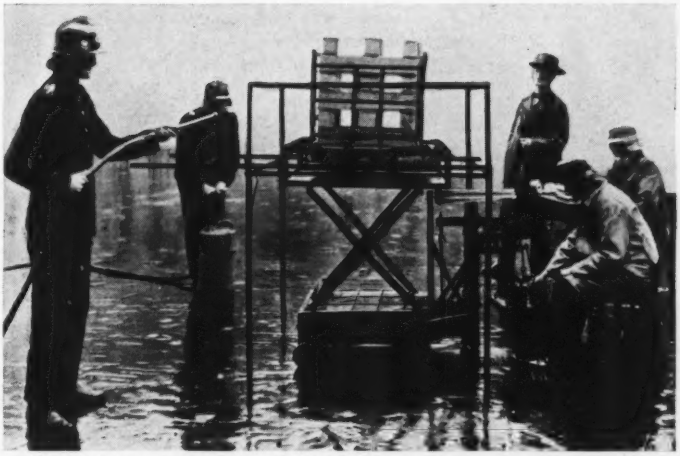


Fig. 8. Relative effect of water and carbon tetrachloride as extinguishing mediums.

experiences. He found that the "soft" streams seemed to be better absorbed by the charcoal than the "hard" streams, and the hard streams may also introduce air as they are injected. Our experiments show Captain Foussoult to be correct since an increase in water pressure did not in any case cause an increase in the residue, but rather diminished it. From them we concluded that, at any rate, with a stream of from 10 to 30 cu. cm. per min. (.61 to 1.8 cu. in. per min.), there will always be required about 1.2 times as large streams of 7.25 mtr. (24 ft.) as of 2.00 mtr. (6½ ft.) water pressure to achieve the same effect. This applies regardless of the extent to which the pile has burned down.

Comparison of Means of Extinguishment.

In the experiments and examination that have been made above we have discussed the conditions applying to extinguishment by means of water. As test object, a burning pile of sticks was chosen because it represents the subjects which are usually found in daily life, and for which water is the most suitable means of extinguishment. In modern developments, a great many sources of fire danger have arisen that are of quite another character, such as fires due to oil, electric short circuits, magnesium compounds, etc. These are fought with other means, such as foam, carbon dioxide, carbon tetrachloride, sand, etc. In comparing these other means of extinguishment, we must of course do so under the conditions for which they are suited, but such experiments are outside the bounds of this present investigation. Here only a few experiments are introduced to investigate the value of certain special extinguishing agents that can be used under the same conditions as water, i.e., carbon tetrachloride and foam.



This outside scale and pile of cross-built sticks was used for performing an extinguishment with mechanical foam. Note the hand pump in the background.

Carbon Tetrachloride.

In Fig. 8 the comparative results of extinguishment with water and with carbon tetrachloride having a water pressure of 2 mtr. (6½ ft.) and applied to a laboratory test object burnt down to 50 per cent are charted. This is a specimen investigation, not further explored. The results show the advantage water has under these conditions, since a water stream of 17 cu. cm. per min. (1.04 cu. in. per min.) gives the same residue as a carbon tetrachloride stream of 42 cu. cm. per min. (2.56 cu. in. per min.). It can be seen that there was no material difference in the course of the extinguishment. Although the CCl_4 stream of 42 cu. cm. per min. (2.56 cu. in. per min.) had an evaporation heat of about 4 kg. cal. per min. (16 B.T.U. per min.) as compared with 10 kg. cal. per min. (40 B.T.U. per min.) in the case of the water stream of 17 cu. cm. per min. (1.04 cu. in. per min.), the suffocating effect of the carbon tetrachloride made the efficiencies equal.

Foam.

The indoor laboratory experiments were not suited for the investigation of extinguishment by means of foam, as suitable foam streams of small dimensions could not be produced. Although in the outdoor experiments one could cover the whole pile of stacked up sticks with foam, the individual piece would not be covered. It is necessary in the application of foam that each surface that is to be extinguished or protected should be covered. Therefore, as a test object, a pile was chosen consisting of 6 layers of four pieces of wood each. The pieces were 60 x 10 x 10 cm. (24 x 4 x 4 in.) in dimension.

Table 2.

Relative effect of water, chemical foam and mechanical air foam as extinguishing agents on a pile of burning wood.

Test No.	Extinguishing Agent	Size of Stream, Liters per Min.	Water Content, Liters per Min.	Time of Extinguishment, Sec.	Total Water Used, Liters
1	Water	1.5	1.5	396	9.9
2	Water	3.0	3.0	72	3.6
3	Chemical foam	11	1.65	217	6.0
4	Air foam	13	1.55	175	4.5

The experiments were conducted with a pile of 75 per cent weight of residue and with streams of about equal water content. The water stream was of 1.5 liters (1.58 qts.) per min. with a water pressure of 20 mtr. (66 ft.). For comparison extinguishment was performed with a stream of chemical foam of 11 liters (11 2/3 qts.) per min., containing 1.65 liters (1.74 qts.) of water per min. and a stream of mechanical air foam of 13 liters (13.76 qts.) per min. carrying 1.55 liters (1.64 qts.) of water per min. Table 2 shows the result of the experiments also embracing an extinguishment with 3 liters (3.17 qts.) of water per minute.

These expensive experiments were not carried further, as they showed clearly that there is no occasion to use expensive foam under these ordinary conditions. The foam is destroyed by the burning surfaces until they are cooled down, and then forms a protective cover. This conforms with experiences in the use of foam for quenching liquid fires. It is effective on light liquids that retain a low temperature, but is difficult of application with heavy liquids which are heated by the fire. The experiments showed how admirably foam is suited to protect surfaces that have not yet been ignited.

Since the use of mechanical air foam had its origin at the fire department of Frederiksberg, it will be readily understood that we have had a special interest in the methodical demonstration of the limits of its right application.

Atlantic City Oil Fire.

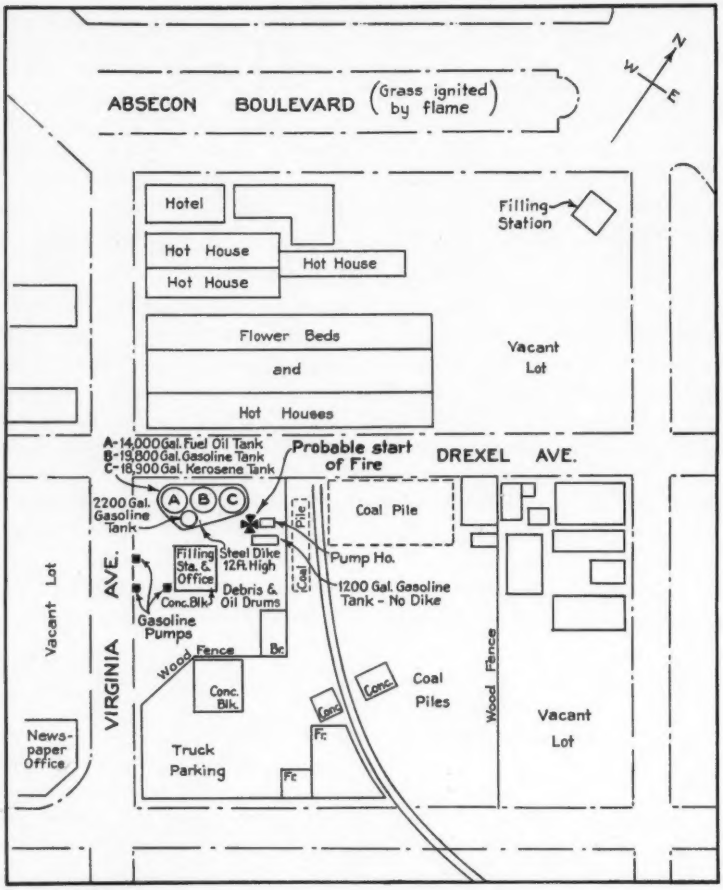
On July 16, 1937, Atlantic City, N. J., witnessed another link in the chain of fire disasters which are the direct result of bad practice in the storage and handling of flammable liquids. The Pure Oil Company combination oil storage and service station burned on that day, constituting a serious hazard to surrounding property and injuring 200 persons, including 60 firemen.

Construction and Occupancy.

The Pure Oil Company plant was located at the corner of Virginia and Drexel Avenues, as shown by the accompanying diagram. Fronting on Virginia Avenue was the one-story office building and filling station. Along Drexel Avenue were a group of aboveground vertical gasoline, kerosene and fuel oil tanks of moderate capacity, the largest holding 19,800 gallons. Four of these tanks were enclosed in a steel dike approximately 12 ft. in height. These tanks were of riveted steel construction of the vertical type, supported on cement foundations which were shown by the fire to be inadequate. A horizontal tank of 1200 gallons capacity was located outside of the dike in the rear of the property. Near this tank was a small pump house. In this rear area there was considerable accumulation of oil drums and miscellaneous débris. In addition to the aboveground tanks, there were several underground tanks.

Pictures, Inc.

Flaming gasoline, leaking through the substandard dike, had already surrounded the filling station buildings and was running out into the street when the fire department arrived.



The station buildings were small and of one-story, mainly concrete block, construction. Gasoline from the storage tanks was dispensed to the public on Virginia Avenue through three pumps of the usual service station type. The plant was bordered across Virginia Avenue on the west by a vacant lot and one-story fire-resistive newspaper plant, across Drexel Avenue on the north by the greenhouses of a florist, and on the west and south by a coal yard.

This plant had been constructed many years before the fire and much of the equipment was of obsolete type. The single 1½ and 2-inch vents provided in the tanks were barely sufficient to permit the normal inflow and outflow of air during filling and emptying. There were no emergency vents to

Acme.

Firemen and spectators were ignorant of the danger of explosion of improperly vented oil tanks when surrounded by fire. When the roof of one of the largest tanks blew off, 60 firemen and 140 spectators were caught by the blast of flame.

relieve pressure under fire conditions as specified in the N.F.P.A. Suggested Ordinance on Flammable Liquids, and the construction of the tanks was not such that the pressure would be relieved by the opening of a seam at the roof line before a dangerous internal pressure had been built up. The dike, little more than a sheet metal fence, was not in accordance with the N.F.P.A. Suggested Ordinance, which calls for concrete or earth dikes having sufficient capacity to hold the contents of the tanks. No foam protection had been provided to offset the substandard features of the gasoline and oil storage.

There was no local ordinance on flammable liquid storage and handling, and no fire department fire prevention bureau or other municipal agency to inspect for fire hazards, though the establishment of such an agency had been recommended by the N.F.P.A. field engineers on various occasions prior to the fire.

Story of the Fire.

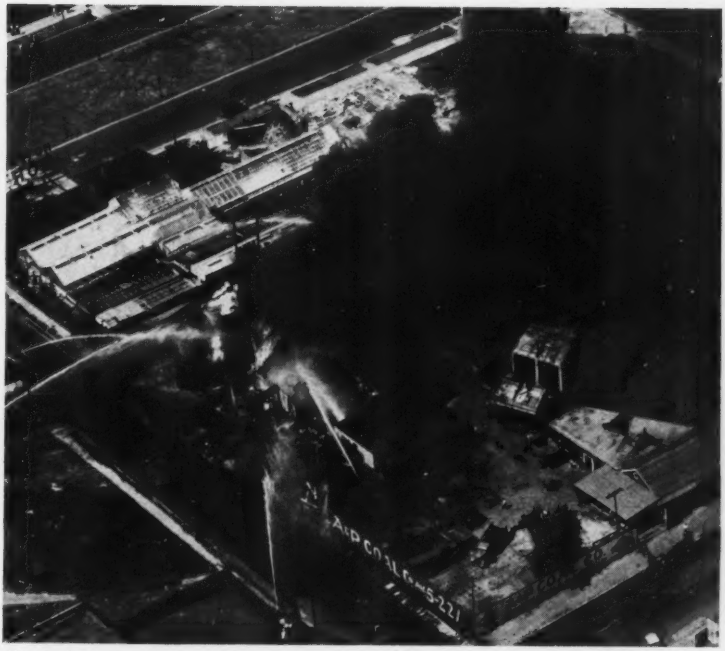
There is no positive information as to the exact cause or point of origin of the fire. A reasonable explanation is that the fire started in or near the pump house and spread rapidly to the near-by 1200-gallon gasoline tank, this tank soon rupturing and spreading the fire to the larger tanks in the dike. Another possibility is that the fire started at or near the filling station build-

Armand F. Jones.

When the roof of the large tank gave way, an immense cloud of flame and gases was liberated with explosion force. Two hundred persons were burned and vegetation more than a block away was destroyed by the heat of the burning gas cloud.

ing. Whatever the immediate cause or exact point of origin, the fire spread with extreme rapidity and within two minutes of the start had involved the entire plant, according to Fire Chief Joseph H. Leeds. The alarm was received by the fire department about 1:15 P.M. On arrival the battalion-chief in charge found the fire of such intensity that he immediately sent in a second and third alarm.

At least one tank appears to have been leaking. The fire department reports that when the companies arrived they found gasoline, and possibly other oils, had escaped beneath the dike and was burning on the pavement and on the ground surrounding the dike. This would seem to indicate leakage from tanks or piping within the dike, ignited by the flare-up from the small horizontal tank. The rapid progress of the fire was also aided by the explosion of several of the drums and barrels of flammable petroleum products in the rear area. By the time firemen arrived on the scene the heat was so intense that they could not approach near enough to fight the fire effectively. With the apparatus and men from the three-alarm response they tried to prevent the spread of the burning oil by means of hose streams. Atlantic City is one of the few cities of its size in the United States having no equipment for foam hose streams, or any other special equipment to combat large oil fires. Hose streams were also played on the tanks in an unsuccessful attempt to keep them cool.

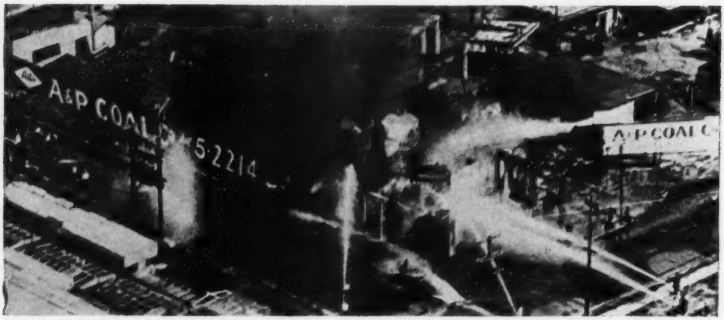


Pictures, Inc.

After the roof of the 20,000-gallon kerosene tank blew off, the firemen and spectators retreated. The burned grass on Absecon Boulevard (upper left of this picture) was ignited by the blast of flames.

Ignorant of the danger of explosion of the improperly vented tanks, a large number of spectators gathered despite the establishment of police lines some distance back from the fire. Many people were on near-by roofs. The pressure in the tanks increased rapidly, due to the intense heat of the surrounding fire, and the tank tops bulged upward. The 1½ and 2-inch vents were totally inadequate. Finally and without warning the roof of the large kerosene tank gave way, liberating with explosive force an immense cloud of flame and unburned gases which reached a great height, spreading over a wide area mainly to the north, the unburned gases igniting at intervals as they formed burnable mixtures with air.

Not expecting such an occurrence, the firemen and many spectators were directly in the path of the cloud of flame and burning gases, and as a result 60 firemen and 140 civilians were so badly burned as to require hospital treatment. Lawns, hedges and other vegetation more than a block away were destroyed by the heat of the burning gas cloud. One of two large tanks that did not explode tilted several degrees on its foundations. For a while it was feared it would topple into Drexel Avenue.



Acme.

When the fire was almost out: Note ruptured roof of 20,000-gallon kerosene tank and complete destruction of concrete block filling station office.

The continued application of water washed much gasoline into the sewers, as a policeman, fireman and doctor discovered when a manhole cover near which they were standing blew 100 feet in the air and landed among some near-by houses. An added though somewhat tardy fire fighting force was provided by the W.P.A. which, after calling up Newark and Washington to see if it could spend the money, rolled to the fire with trucks and sand to dam the flow of gasoline.

Cause and Loss.

The cause of this fire has not been definitely determined, although Chief Leeds attributed it to a cigarette tossed away on ground that was soaked with gasoline from a leaking tank or piping. The loss was reported to be $75,000 exclusive of claims for liability for the personal injury of some two hundred persons.

NOTE: This account has been prepared from data obtained from Mr. H. E. Newell of the National Board of Fire Underwriters, Secretary of the N. F. P. A. Committee on Flammable Liquids, from the Schedule Rating Office of New Jersey (Member N.F.P.A.), from personal observations by members of the N.F.P.A. staff, and information from various other sources.

S.S. City of Baltimore Fire.

The Chesapeake Steamship Company steamer *City of Baltimore* burst into a mass of flames from stem to stern within three minutes after discovery of fire in its hold at 7:30 P.M. on July 29, 1937. One of the forty passengers and two of the fifty-three members of the crew on board drowned when they leaped from the burning ship. The fire originated in some cargo on the freight deck from an undetermined cause about an hour after the ship left Baltimore for Norfolk, Virginia. The disaster occurred about one and one-half miles off Bodkin Point, which is about 14 miles from Baltimore in Baltimore Harbor.

The Ship and Cargo.

The *City of Baltimore* was a three-deck steamer built in 1911, was 297 feet long and of 2378 gross tons. The superstructure was wood and the hull was steel. There were accommodations for four hundred passengers on this overnight liner, which plied regularly between Baltimore and Norfolk with passengers and cargo. In addition to the 93 persons on board at the time of the disaster, there was considerable cargo, including general merchandise, package freight, 2000 bags of sugar, drums of alcohol, and about 30 automobiles with their tanks containing gasoline.

Information relative to the kind and amount of fire protection facilities provided on the ship is not definitely known, as the investigation conducted by the Bureau of Marine Inspection and Navigation of the U. S. Department of Commerce is not yet completed. According to testimony of members of the crew and survivors, there were standpipes and hose with two fire pumps, a sprinkler system, an alarm system, and fire extinguishers on the ship.

Story of the Fire.

The fire was said to have been discovered by a kitchen helper when he noticed smoke issuing from the forward section of the freight deck. Apparently the fire started on the port side near a porthole, where the cargo was sugar in burlap bags and merchandise in paper cartons. The kitchen crew attempted to extinguish the fire with buckets of water, but this proved inadequate because the fire was spreading rapidly. A general alarm was sounded. Nearly all of the passengers were in the salon or dining room at the time. Members of the crew rushed to their fire stations and to the lifeboats and assisted the passengers in putting on life preservers. The sudden burst of flames from the lower decks spread almost instantly from stem to stern, fanned by a 20-mile wind. The terrific heat forced the passengers into the bow, where they huddled for about fifteen minutes until the fire forced them overboard. Most of the six lifeboats were launched, but many of the passengers and crew

Baltimore Sun.

Air view, showing the twisted and smoldering wreckage of the S.S. City of Baltimore, caused by the fire which suddenly involved it from stem to stern in Baltimore Harbor on July 29, 1937, and resulted in the loss of one passenger and two members of the ship's crew.

could not reach them because of the heat, so they dropped over the sides, after holding on to the railings as long as they could. Several slid down a rope which someone fastened to the railing at the bow.

There was a series of blasts soon after the fire started, most of which probably were gasoline tanks on the automobiles exploding. However, some of the survivors said that some of the explosions preceded the fire. With flames shooting high into the air, the captain headed the ship toward land and stopped on a sand bank about a half mile from shore. By this time many motor boats and various craft in the harbor had assembled to assist in rescue work. The nearest boat at the time the *City of Baltimore* burst into flame was a 38-foot fishing boat, which picked up two men, one of whom was unconscious and was given artificial respiration. Some of the larger boats could not get very near because of shallow water, and the smaller boats were handicapped because of the intense heat which radiated from the burning ship.

Fire Fighting Ineffective.

Some of the passengers aided the crew in dragging fire hose to the flames, but what happened then is not certain. Some survivors said that water was turned on and others said the controls were turned on but no water flowed — whichever the case, the men were driven back by the heat. The watchman aboard the ship reported that he saw the sprinkler system working in the after section of the ship. The chief engineer testified that the sprinkler system and both the fire pumps were operating. The captain said that all the ship's hose lines were brought into service, but he couldn't say whether or not he had seen any water coming from them. In any case, whatever water came from hose and sprinklers had no effect on the fire. The Baltimore Fire Department immediately dispatched two fireboats, seven ambulances, and flood lighting equipment to the scene. The fireboats worked for 20 hours to extinguish the fire. Later the water was pumped out of the hull to permit investigations as to the start and rapid spread of the fire.

The ship was burned to the water's edge, leaving a mass of tangled metal, as shown by the accompanying photograph. The entire superstructure, including the wooden upper deck, was completely destroyed and the wooden freight deck below burnt through and collapsed. The hull and cargo were sold for salvage at $12,950. Had it not been for the prompt assistance of boats in the harbor, it is most likely that many more than three lives would have been lost.

The cause of the fire has not been determined. The captain was suspicious of sabotage because of the rapidity with which the fire spread. An inspector of the Bureau of Marine Inspection and Navigation, however, said there was no evidence of sabotage, and that he believed a cigarette or cigar caused the fire. While witnesses on shore and some of the survivors said the

flames seemed to shoot forth suddenly, some of the survivors indicated that the fire had raged in the hold some time before enveloping the entire ship.

On June 24, a month and four days before this disaster, the *City of Baltimore* had a grease fire in the galley while docked at Norfolk. The flames spread rapidly, shooting several feet above the hurricane deck. Norfolk firemen soon got the flames under control and the ship proceeded later that day for Baltimore. Whether the disaster on July 29 was due to the same cause as the earlier fire is not known.

Fox Film Storage Fire.

Report by Schedule Rating Office of N. J.

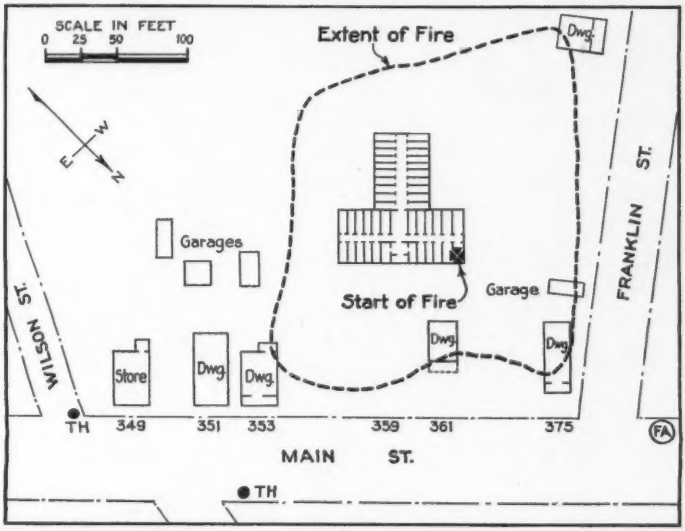
(Member N.F.P.A.)

A serious fire occurred early on the morning of July 9, 1937, in the film storage building of the Fox Film Corporation, located in a residential district of Little Ferry, New Jersey. It destroyed all films stored in the structure and severely damaged the entire building. Flames from the rapidly burning nitrocellulose film shot high into the air and also horizontally over the ground a distance of over 100 feet, thus involving three near-by frame dwellings. The total property damage is estimated conservatively at $150,000. A family of three who resided in one of these near-by dwellings were severely burned in making their exit. One of these persons, a boy 13 years of age, was so severely burned that he later died of his injuries.

Construction and Occupancy.

The original structure, built early in 1935, was constructed with 12-inch brick exterior walls one story in height without parapets and without basement. The roof was a 4-inch reinforced concrete slab. This structure was added to in the fall of 1935 and again early in 1936. The construction of the additions was identical to that of the original. At the time of fire the total ground area was 5099 square feet. The entire floor was of cement on the ground. The building was used exclusively for the storage of old motion picture film. Some of the film was as much as 25 years old and none was less than five years old.

The structure was divided into 46 separate film storage vaults, each 5 feet wide by 15 feet deep and 10 feet in height. These vaults were arranged on both sides of two central corridors. The partitions between vaults were open finish 8-inch brick, extending from floor to roof. Access to the vaults was through doorways in the corridor walls, each protected by a single Class "C" automatic labeled fire door. Each door was reinforced by 1/16th-inch thick sheet iron, bolted on both sides.



The fire area. Flame shooting from the film storage building caused the ignition of frame dwellings over one hundred feet distant.

There were 42 individual vaults, which extended from central corridors to the outside brick walls of the structure. Each vault was vented by a single window opening, 18 inches by 22 inches. There were four inside vaults which were vented by single openings 24 inches by 24 inches in the roof. The window vents were plain glass in metal sash and the roof vents were wired glass in metal sash. All vents were held closed with fusible links and chain. No mechanical system of ventilation was provided. Each of the wall and roof vents was covered on the outside with a sheet steel hood, open-side downward. Metal shelving was provided for storage in each vault.

A centrally located room within this structure was used as office and shipping room. This room was vented by a skylight of metal frame, glazed with ¼-inch wired glass. The building was lighted by electricity, with vapor-proof globes provided throughout, and wiring laid in good metal conduit. Ordinary snap switches were located in the central corridors and office portion of the building. The office was heated during winter months by a single city gas radiator, safely installed. No other portions were heated. No automatic sprinkler protection was provided.

Film was received at the vaults in the usual metal containers, each holding one reel of film. These cans were usually stored as received. The old "Educational" brand of film produced by this corporation, however, was sorted daily in the centrally located office section by two employees. Film in con-

The front of the film storage building after the fire. In the foreground are cases of burned film removed from the vaults for reclamation of silver. Note the roof vents to the four inside vaults which were blown out by the explosions. Although window vents operated, the force of the explosions was sufficient to tear out 12-inch brick piers between window vents in places.

tainers was then placed in individual film storage vaults. The capacity of each vault was about 1000 reels of film, and each was normally filled to about 80% of capacity. It is estimated that there were approximately 40,000 cans of film stored at the time of the fire. The building was opened at 8:00 A.M. and closed at 4:30 P.M. daily. No watchman service was maintained, although an employee lived in the adjacent dwelling at 361 Main street, which was 42 feet away.

Story of Fire.

For several days just prior to and including July 9, 1937, New Jersey suffered extremely warm weather. Little relief was afforded by the blanket of night and the temperature throughout these days ranged in the neighborhood of 100° F. Shortly after 2:00 A.M. on the day of the fire, a truck driver on his way to work, proceeding westerly along Main Street, noted flames shooting from the window vent at the northwest corner of the vaults as he approached. He ran to the municipal fire alarm box located at the southwest corner of Main and Franklin Streets, 150 feet distant, and as he passed the burning film vaults, the radiated heat was so intense that he had to shield his face with a cloth jumper which he was carrying. This alarm was recorded at Little Ferry Fire Department Headquarters at 2:15 A.M. The young man then proceeded to awaken residents of the dwellings in the immediate vicinity by shouting. The family residing in the frame dwelling located immediately in front of the film storage vaults (361 Main Street) was first aroused and escaped from their dwelling with only their night clothes. In the few seconds which had elapsed since discovery of fire the heat and flames had increased so rapidly that

This view of a side wall of the structure shows severe spalling of brickwork on the walls, evidencing the severe heat of the fire.

the entire rear portion of this dwelling caught fire. A man who resided with his family in the dwelling at 353 Main Street came out of his dwelling about this time and assisted members of the family from 361 to safety. He was under the impression that his own family had escaped with him, but while he was assisting the family living in 361, his wife and two young boys came out of their house from the street entrance and attempted to run across the street. As his wife stepped down from the curb in front of her home, she stumbled and fell. One of her sons ran back to assist her. At this moment, accumulated gases of decomposition in the vault adjoining the one which was burning, exploded, and a sheet of flame was discharged from the window vent horizontally many feet northeast across Main Street, engulfing all three persons. The 13-year-old boy was in such a position as to shield his mother to some extent and was burned very severely. All three persons suffered second and third degree burns and this boy died from his injuries on July 19.

Shortly after this, the Little Ferry Fire Department arrived with two pumping engines, and one hook and ladder truck and proceeded to connect to the two hydrants immediately available. The heat at this time had increased to such an extent that it was impossible for firemen to approach the burning structure closer than about 100 feet. Hose streams were directed on the frame dwellings at 361, 375, and 353 Main Street, which by this time had taken fire. Chief Kuss of the Little Ferry Fire Department on his arrival at about 2:26 A.M. realized the probable extent of the fire and immediately dispatched a second alarm, calling out additional volunteer firemen. A radio police car equipped with a radio transmitter passed the scene on State Highway Route No. 6 at about this time and reported the fire to county police headquarters at

Hackensack, New Jersey. This police call was re-transmitted over the police radio system immediately to adjoining municipalities. Without further call, the towns of Riveredge, Hawthorne, Ridgefield, and Lodi Township dispatched apparatus and men to the scene of the fire. These out-of-town fire companies all arrived shortly after 2:30 A.M., and proceeded to assist the Little Ferry Fire Department by connecting to other available hydrants in the vicinity. In all, seven companies, totaling approximately 150 men, three pumping engines, two hose carts, and two hook and ladder trucks responded. Fourteen hose streams were used and a total of about 3000 feet of hose was laid. The fire was officially out at 5:30 A.M.

Heat evolved from the burning vaults caused a high temperature in the area immediately surrounding the entire building. Decomposition of the film stored in the vaults immediately adjacent to those on fire ensued. As the gases of decomposition accumulated, pressure within the vaults forced the gases out of the wall or roof vents. Ignition of these vented gases, either spontaneously or by means of the adjacent flames, resulted in severe puffs or explosions, projecting flames horizontally for well over 100 feet from the wall vents and vertically from the roof vents for considerable distances. These so-called explosions occurred intermittently for about an hour, at which time the last film vault became involved in the fire. By this time the fire had burned itself out and the firemen were able to approach and enter the structure. It was then found that the fire doors on the vaults were all closed and padlocked. It was, therefore, necessary to wet down the vault contents through the exterior vents.

Fusible Links on Vents.

Investigation after the fire disclosed that all of the fusible links provided to hold the window and roof vents in a closed position had operated and all vents were in full open position. When padlocks on the fire doors were opened it was found that film cans stored in the vaults were intact, with lids still in place and piled just as they had been prior to the fire. The cans, however, were badly scorched and contained only ashes — the nitrocellulose film had completely decomposed. There was not a single roll of film in the structure which was not destroyed.

Vaults located at the extreme south and east wings of the structure, which were involved late in the fire, suffered most from explosion. The 8-inch brick partition walls between these vaults and also the 12-inch brickwork between the exterior wall vents were blown out in several places. The force of the explosion here was, no doubt, due to the fact that decomposition was more complete in these vaults, with consequent greater gas volume and pressure; hence a larger and more violent explosion followed ignition. Interior walls of the building were badly spalled and appeared to be extremely brittle, with numerous vertical cracks showing. The exterior brick walls, 12 inches in thickness, remain intact except as previously mentioned.

The rear portion of the frame dwelling located 42 feet distant and directly in front of the film vaults suggests the intense exposure to which it was subjected. Note the roof of the dwelling in the background, which was ignited by burning débris.

The heavy gauge sheet steel hoods which were arranged over each of the wall and roof vents and bolted to the outside of the metal window frames were bent outward and in some cases blown off by the force of the explosion. It is probable that deflection of the initial force of the explosions toward the ground by means of the hoods was a factor in preventing greater damage to life and property.

During the height of the fire many firemen noted that the 4-inch reinforced concrete roof over the vault structure appeared to rise several inches as each explosion occurred and settle back into place after the blast. This roof was noted to be badly bulged at numerous points and bowed above the brickwork at several points.

The exterior walls of the building from the ground to a point about 4 feet high appear to have come through the fire in good condition. It will probably be necessary to replace the damaged brickwork above this point to the roof line. The parts of the reinforced concrete roof over the northwest section of the building where the fire started appear to be in fair condition, but no doubt will also be replaced if the building is to be again used for film storage purposes.

The metal cans which contained the films are a total loss and have been discarded. Fifty-seven truck loads of these cans have been carted from the building. The ashes of the burned nitrocellulose will be salvaged for silver content. It is estimated that each can of film ashes will yield approximately 5 cents worth of silver.

Conclusions.

Though not definitely established, the only plausible cause of this fire seems to be spontaneous ignition.

During the past ten years there have been seven fires of unknown origin, all involving the storage of nitrocellulose and all occurring during extreme hot spells during the months of June, July, and August.

Spontaneous ignition of new motion picture film under standard conditions of storage has not been reported. The operation of modern film exchanges handling new film even in hot climates has not involved an unfavorable fire record. All recent fires where spontaneous ignition of film has been suspected have been in connection with old or scrap material. It is a well-known fact that scrap nitrocellulose material has a greater fire hazard than the new material and that some nitrocellulose products tend to deteriorate with age, becoming less stable and more subject to decomposition after a long period of years. It is also possible that nitrocellulose film manufactured twenty or twenty-five years ago may not have been as well stabilized as the present American product and thus may be more subject to the possibility of spontaneous decomposition than the film in current use.

This fire, like other recent fires in nitrocellulose, illustrates most forcefully the necessity for strict compliance with the Regulations on this subject developed by the N.F.P.A. Committee on Hazardous Chemicals and Explosives and published by the National Board of Fire Underwriters.

In this particular fire the lack of automatic sprinkler protection constituted a very serious defect. This protection might have been the means of preventing decomposition of film in adjacent vaults (not at the time involved in the fire) by cooling the containers and their contents below the decomposition temperature, together with its value in controlling or at least retarding the actual fire in the vaults so involved. Vents were definitely inadequate and other construction details deviated from established standards.

Another Philadelphia Pier Fire.

The second serious Philadelphia railroad pier fire of 1937 occurred on August 14, this time on Pier No. 10 of the Pennsylvania Railroad. The previous one had taken place on May 30 on a pier of the Baltimore and Ohio Railroad, resulting in a $185,000 loss (see July QUARTERLY, page 56). By the time this fire was extinguished the loss was reported to have reached over a quarter of a million dollars.

Construction and Occupancy.

This pier is owned and operated by the Pennsylvania Railroad, as a transfer and delivery pier, and also for the storage of unclaimed baggage. It is 567 feet long, and 185 feet wide, constructed of timber piling overlaid by a wooden deck. The shed was one story high, with corrugated iron sides on an iron frame. Its roof was of wood plank with a slag covering having skylights 6 feet by 8 feet about every 40 feet. There was a short three-story section at the land end of the pier. Interior fire protection consisted of a 3-inch standpipe with outlets to 2½-inch fire hose lines every 75 feet along the pier. There were also several 50-gallon soda-acid extinguishers on trucks, and frequent barrels of water with buckets. There were no automatic sprinklers nor fire wall subdivision of either the substructure or superstructure as recommended in the N.F.P.A. standard on Piers and Wharves.

Story of the Fire.

At about 1:15 P.M. fire was discovered in the unclaimed freight at the extreme end of the pier by employees of the railroad. At that time it appeared little more than a flicker of flame and they set about to extinguish it themselves with the available equipment. Before they could bring either one of the chemical extinguishers or a hose stream into play on the fire, however, the entire end of the pier was in flames. According to Fire Marshal Jacob S. Clinton of Philadelphia (member N.F.P.A.), the employees continued to fight the fire for some fifteen or twenty minutes before an alarm was sent to the city department; it was then sent by a passing truck driver who saw the smoke and reflection of the flames in the water. According to the testimony of the management of the pier, however, the employees sent the alarm to the city fire department promptly. Irrespective of the exact time of sending the alarm, this fire affords a striking illustration of the importance of calling the fire department promptly.

When the department arrived the private fire fighters had retreated from the pier, badly burned, and virtually the entire structure was in flames. The battalion chief in charge sent in a second and third alarm immediately upon

Pictures, Inc.

Fireboats in the docks were effective in preventing a sweeping conflagration on the waterfront. This picture was taken shortly after the arrival of the department. Note that the pier is already seriously involved.

reaching the fire, and this was followed shortly by a fourth. The equipment brought by the four alarms, including several fireboats, was skillfully handled and the fire was prevented from spreading to adjacent property. Firemen who carried hose streams into the pier itself were soon driven out by the collapse of the iron framework supporting the shed. They had to content themselves, therefore, with pouring water on the fire from the land side, while fireboats drowned it from the harbor side. The fireboats were especially effective in preventing what would have been a very serious exposure to near-by piers. Under such a barrage, the fire was brought under control in about an hour. Hose streams, however, were played on the smoldering ruins until far into the night.

Cause and Loss.

It is reported that there was a considerable amount of mixed freight at the end of the pier where the fire started. It consisted of a large amount of unslaked lime in paper bags, drums of vegetable oils, paints in cans, insecticides, furniture wrapped in excelsior padding, and many other combustible commodities. The fire started among these materials. According to Fire Marshal Clinton, there is no doubt that it was caused by spontaneous ignition. It appears to have worked through the pier deck and spread under the floor before breaking through the top of the pile of freight and making itself known to the employees. At the time of ignition, a ten-mile per hour wind, blowing through the 12-foot clearance of the pier above the water at ebb tide, was ready to aid the spread of the fire beneath the flooring. Had this area of the pier been cut off or sprinklered, it is the opinion of the inspectors that the fire would have been confined to the immediate area of origin. As it was not, the

loss was over a quarter of a million dollars, including complete destruction to the structure, and a $15,000 loss of freight.

It is interesting that this fire should occur in the midst of agitation on the part of Philadelphia fire officials for better protection along the waterfront. A Pier Fire Prevention Committee has studied the hazards of Philadelphia piers and the measures which may be taken to eliminate them. Shortly after this fire, the committee completed its "Recommended Regulations Governing Piers and Wharves." They prescribe fire walls, sprinkler systems, and first aid fire fighting equipment, depending on the conditions on the particular pier.

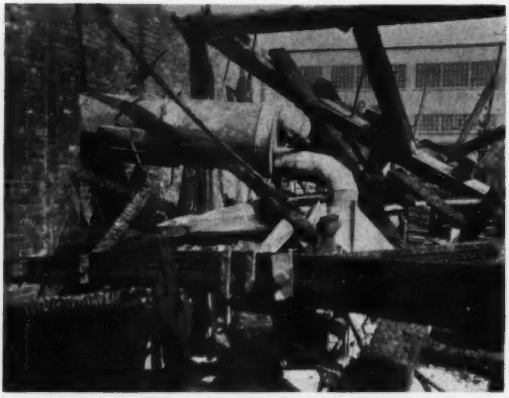
Zinc Factory Fire, York, Ontario.

By W. J. Scott, Fire Marshal of Ontario,
(Member N.F.P.A.)

Buckets of water thrown on an incipient oil fire were responsible for the complete destruction of one section of the plant of the Watts Chemical Co. in York Township, Ontario, on July 30, 1937. The building involved was a one-story brick structure, about 60 by 70 ft., used for the manufacture of zinc dust, zinc alloys and other zinc products.

Eleven oil-fired brick furnaces were used in the manufacturing processes of this factory. The fire originated from an oil burner connected to one of these. According to the story obtained from the furnace operator, he had started up one of the furnaces during the noon lunch hour. As usual, he placed an oily rag in the opening of the furnace and lit it with a piece of paper. This par-

Buckets of water thrown on a fire in oil escaping from a clogged oil burner spread the flames to ignite zinc dust on beams overhead, resulting in the destruction of this section of the plant of the Watts Chemical Co., York, Ontario.



The oil burning furnace where the fire started.

ticular furnace did not work well at times, since dirt in the oil caused a sputtering which allowed oil to drip to the floor. On this occasion, however, when the operator lighted this furnace it appeared to be working satisfactorily. He left to tend another furnace.

In a few minutes he noticed that there was a blaze alongside the defective burner. He ran over to it and saw that the oil on the floor was burning. Unable to locate any "dead zinc" with which he usually put out such fires, he went for a pail of water and threw it on the burning oil. This only spread the flames. He threw on a second pail of water and was bringing back a third when the fire gained such headway and the smoke was so thick he decided to turn in a fire alarm. A call was put in to the York Township Fire Department and the Toronto Fire Department. By that time the fire had reached the beam above the furnace and the zinc dust which had settled on the beam was falling from it in a shower of flames. The fire spread from this beam and involved the rest of the zinc room before fire fighting equipment could be employed. The fire departments saved the other parts of the plant. However, sparks from the burning building threatened surrounding houses and two of them were reported to have caught fire. The loss in the fire was $14,000.

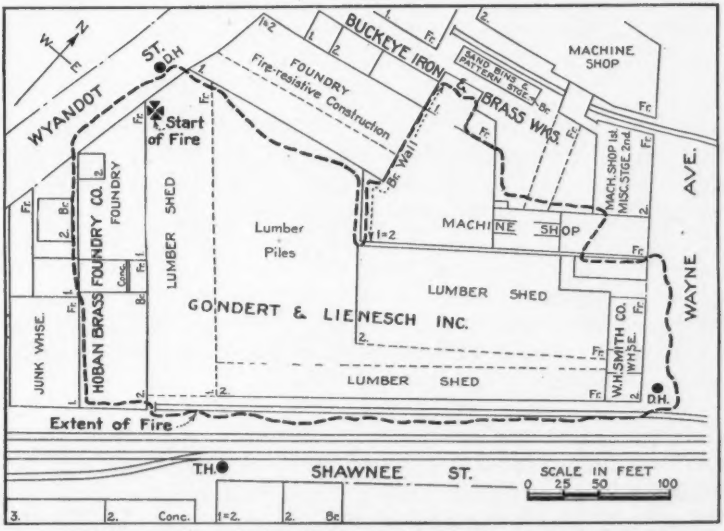
Dayton Lumber Yard Fire.

Report by Ohio Inspection Bureau.
(Member N.F.P.A.)

A fire which reached conflagration proportions occurred on June 15, 1937, in a Dayton, Ohio, block consisting principally of a lumber yard of the Gondert and Lienesch box factory and two brass foundries. The fire involved industrial property only, but threatened several city blocks of industrial, mercantile, and dwelling property in a congested value district of the city. The large amount of combustible construction, a strong changeable wind and the intense heat of the fire seriously handicapped the firemen in extinguishing the fire.

Construction and Occupancy.

As shown in the accompanying diagram, the block involved in the fire was triangular in shape, built up mostly in frame construction. The fire area was covered by a large lumber yard with wooden lumber sheds and centrally located open lumber storage, a large frame machine shop of the Buckeye Iron and Brass Works, a frame lumber warehouse operated under the name of Walter H. Smith Company, and a frame foundry, as well as a brick and a



Spread by a southwest wind, the fire quickly involved most of the frame construction in the block. Note the effective barrier afforded by the fire-resistive foundry and brick wall on the north.

Tinder dry lumber piled high in frame sheds sent spectacular flames hundreds of feet in the air.

concrete section of the Hoban Brass Foundry Company. Across Wayne Avenue were the sprinklered brick buildings of a paint factory and across Shawnee Street the sprinklered box factory of Gondert and Lienesch, Inc.

Story of the Fire.

At 1:45 A.M. on June 15, the Dayton Fire Department received a still alarm and within five minutes after that, a second and third. A special alarm was sent in at 2:07 A.M. by the district chief, calling all available equipment. For about an hour the only immediately available protection for the rest of the city consisted of one engine and one ladder truck. After that, reserve equipment and men off duty were put in service.

The fire apparently started in the Gondert & Lienesch lumber shed adjacent to the Hoban Brass Foundry Company or in the Hoban Company itself. Both concerns employed watchmen making hourly rounds to key stations. Both watchmen were on duty the night of the fire.

The fire, starting in the southwest corner, was aided in sweeping across the old lumber sheds and lumber piles by a southwest wind. By the time the department could assemble sufficient strength to offer resistance to the rapidly spreading flames, the machine shop of the Buckeye Iron and Brass Works Company had ignited. Firemen battled persistently, pushing the flames back toward the center of the lumber yard. Then the wind changed and came

By determined fire fighting with good equipment, firemen were able to save a large paint factory (at their backs in this picture) from serious exposure damage.

directly from the west. This made it necessary to shift the attack to protect the large fireproof and brick sprinklered paint and varnish factory to the east across 66 foot Wayne Avenue. The department was successful in this and no sprinkler heads inside the building opened. Later the wind swung around into the northeast. This aided the department somewhat and at about 4:45 A.M. the chief considered the fire under control. However, no relief was given the men on duty until 10 A.M., some five hours later. Several lines of hose were left in service even after that and the fire was not finally extinguished until about 5:00 in the afternoon.

Box cars on a siding were ignited from the heat of the burning lumber shed on the southeast of the lumber yard.

The congested values and structural characteristics of this block were such that the fire department was seriously handicapped in attempting to control the fire. Thirty-eight firemen received medical treatment, although only eight went off duty. One was injured seriously. One piece of equipment was lost. This was a siamese connection holder, which broke under pressure, driving a piece of metal into a fireman's arm.

It is interesting to note the effect of superior construction in helping to control this fire. The fire-resistive foundry of the Buckeye Iron and Brass Works, which was equipped for just such a fire by wire glass windows on all sides, and a solid brick fire wall on the side adjoining the frame machine shop, was relatively easily protected from the entrance of fire. On the southwest, while the brick and concrete sections of the Hoban Brass Foundry were involved, there is no doubt that they assisted in stopping the fire. Other lines of the fire area were along streets, except for one area where the fire department was able to stop the fire's progress through the frame construction of the Buckeye Machine Shop.

Cause and Loss.

The cause of this fire has not been determined, although it is thought that transients spending the night in the lumber shed of the box factory may have been responsible. Another theory is that the fire may have started in a cupola of the Hoban Brass Foundry. The total damage in the fire amounted to about $300,000. It is just another example of what is sure to occur in large areas of undivided and unprotected frame construction. It demonstrates the danger of such plants being located in districts of high value concentration.

Fires and Losses by Occupancy and Cause.

By DeWayne E. Nolting,
N.F.P.A. Department of Fire Record.

There are no complete National statistics on the distribution of the fire loss in the United States, either by causes or by occupancy classes. To meet the need for such information, the following tabulations have been prepared by the N.F.P.A. Department of Fire Record from the reports of fire marshals.

The information was obtained from twelve state and five provincial fire marshals' reports covering the year 1936. Reports of these particular states and provinces were chosen because they were more complete than others which were submitted and the classifications employed in them were such as to permit reasonable comparisons. The record keeping procedures and the character of information published in the annual reports of fire marshals are different in each case, owing to different legislative requirements and precedents of the various offices. In several states, notably Maine, Minnesota, Nebraska, North Dakota, Oklahoma, Texas, Virginia, and West Virginia, and in the provinces of Alberta and Prince Edward Island the statistics reported were satisfactory in respect to the information presented, but were not sufficiently complete in all details to be included in this study.

In the majority of the twelve states the figures include only fires causing a loss of over some specified figure, as other fires are generally considered too trivial to be reported to state fire marshals. Some figures are insurance losses only, while in perhaps the majority of cases the insurance losses paid are supplemented by estimates made by fire chiefs on losses which were not insured. As a rule the data from rural sections not having organized fire protection facilities are incomplete despite the best efforts of the fire marshals to secure reports. Notwithstanding these differences it is believed that the volume of statistics from the twelve typical states and the five provinces included herein is sufficiently large to indicate the relative distribution of fires and fire losses in the entire country for the various occupancies and causes, though owing to differences in reporting methods some of the details may be open to question.

The first six tables which follow are tabulations made from the fire marshals' reports. Table I shows the number of fires by occupancies and Table II shows the fire loss by occupancies reported for the year 1936 in the twelve states. Tables III and IV show the number of fires and fire losses distributed according to causes. The general classes making up both the occupancy and cause classifications were carefully chosen with regard to good practice and to classes most commonly used in the fire marshals' reports. Tables V and VI show similar information for the five provinces in Canada for 1936.

Table I. Number of Fires by Occupancies in Twelve States — 1936.

Occupancy	Illinois	Indiana*	Iowa	Kansas	Louisiana	Massachusetts	Ohio	Oregon†	South Dakota*	Vermont	Washington†	Wisconsin	Totals
I. Public Buildings													
Government buildings	2	12	1	....	....	47	....	....	2	2	....	5	71
Hospitals and institutions	7	3	6	6	21	13	6	13	....	4	9	22	110
Schools	96	31	33	35	31	29	29	33	5	24	31	72	449
Churches	94	29	23	35	17	34	42	15	7	12	23	72	403
Amusement buildings	90	40	29	12	9	105	74	22	11	9	67	90	558
II. Dwelling Occupancies													
Hotels	348	26	30	27	62	45	54	335	26*a*	10	266	126	1,355
Lodging houses	....	....	10	....	....	129	59	....	....	....	59	64	321
Apartments	2,269	64	81	....	....	....	604	....	....	....	339	139	3,496
City dwellings	7,798*b*	2,760	3,058	2,405	2,406*b*	4,698*b*	9,092*b*	3,332*c*	326*b*	1,086	2,299	8,342*b*	47,602
Farm dwellings	....	719	563	984*d*	....	....	....	406	....	620*d*	706	....	3,998
III. Mercantiles													
Office buildings	174	24	48	....	....	....	34	....	13	....	32	42	367
Small retail stores	1,604	92	316	19	....	1,121*e*	1,404	....	114*f*	....	192	777	5,639
Restaurants	261	46	76	....	....	88	67	61	....	....	99	47	745
Miscellaneous mercantiles	....	287	....	443	391	98	....	505	....	212	179	....	2,115
Storage warehouses	96	94	91	....	33	147	149	16	....	2	83	109	820
IV. Manufacturing													
Textiles, fabric workers	....	....	....	....	115	25	....	20*g*	....	3	7	7	177
Metal workers	29	9	4	2	6	29	11	20	7	1	31	32	181
Woodworkers	9	....	....	7	16	7	....	42*h*	....	11	78	10	180
Food products	86	32	37	26	15	35	47	22	15	4	69	116	504
Flammable liquids and gases	52	12	8	....	....	11	27	....	1	....	15	19	145
Miscellaneous manufacturing	388	84	81	31	44	325	346	44	7	9	18	149	1,526
V. Miscellaneous Bldgs.													
Farm barns	....	296	385	....	....	194	1,141	70	84	....	77	515	2,762
Farm outbuildings	1,940	195	294	55	....	136	733	45	....	....	83	213	3,694
Lumber yards	20	6	18	3	1	19	23	....	....	....	3	20	113
Railroad, wharf property	44	18	17	34*i*	10*i*	47	21	17	5	....	4	....	217
Bulk oil storage	1	....	7	51*j*	35*j*	....	....	14*j*	....	....	....	....	108
Garages, filling stations	1,241	233	337	11	16	250	1,143	19	62	19	89	363	3,783
Miscellaneous buildings	850	38	389	45	41	211	554	29	6	34	61	280	2,538
Outdoor fires	2,074	230	609	277	322	710	1,292	138	48	....	37	1,346	7,083
Totals	19,573	5,380	6,551	4,508	3,591	8,553	16,952	5,218	739	2,062	4,956	12,977	91,060

a. Includes restaurants.
b. Includes farm dwellings.
c. Includes apartments and garages.
d. Includes other farm property.
e. Includes combination stores and dwellings.
f. Includes warehouses.
g. Includes dry cleaners and laundries.
h. Includes lumber yards.
i. Includes light and power plants.
j. Includes filling stations and refineries.
*Fiscal year ending June 30, 1936.
†Insurance losses only.

Table II. Fire Loss by Occupancies in Twelve States — 1936.

Occupancy	Illinois	Indiana*	Iowa	Kansas	Louisiana	Massachusetts	Ohio	Oregon†	South Dakota*	Vermont	Washington†	Wisconsin	Totals
I. Public Buildings													
Government buildings	$1.55	$14,209	$125	....	....	$70,552	....	....	$2,410	$885	.....	$10,352	$98,688
Hospitals and institutions	710	3,545	280,307	30,214	16,952	3,634	9,679	9,710	....	9,361	$8,114	4,479	376,705
Schools	404,085	385,053	171,580	272,684	217,080	465,880	94,240	90,699	87,899	49,831	127,395	288,876	2,655,302
Churches	363,774	104,933	35,986	72,401	13,959	141,370	54,607	42,971	41,665	26,220	14,210	50,249	962,345
Amusement buildings	266,011	64,626	51,971	12,058	14,381	253,405	142,335	68,389	9,896	22,394	18,959	75,426	999,851
II. Dwelling Occupancies													
Hotels	171,074	28,359	20,614	11,501	53,334	39,629	118,592	78,703	23,064*a*	56,013	74,440	34,205	709,528
Lodging houses	....	....	885	....	....	128,669	39,809	....	....	....	16,624	11,554	197,541
Apartments	408,648	36,814	29,755	....	....	....	749,318	....	....	....	95,715	18,327	1,338,577
City dwellings	3,868,399*b*	901,014	993,466	644,397	1,057,074*b*	3,352,834*b*	3,180,456*b*	1,252,432*c*	253,144*b*	270,596	430,812	1,974,965*b*	18,179,589
Farm dwellings	....	1,116,047	1,294,601	1,292,746*d*	....	....	....	320,844	....	630,233*d*	571,555	....	5,226,026
III. Mercantiles													
Office buildings	122,185	18,169	24,426	....	....	....	37,775	....	5,514	....	20,138	21,352	249,559
Small retail stores	1,435,627	71,791	593,007	3,848	....	1,941,939*e*	2,928,575	....	154,962*f*	....	112,402	682,816	7,924,967
Restaurants	222,238	16,788	62,743	....	....	137,864	67,341	23,909	....	....	46,764	13,952	591,599
Miscellaneous mercantiles	....	725,074	....	551,270	388,485	290,899	....	560,963	....	187,562	151,256	....	2,855,509
Storage warehouses	306,462	222,442	219,160	....	23,750	326,434	940,002	26,915	....	7,820	209,836	457,870	2,740,691
IV. Manufacturing													
Textiles, fabric workers	....	....	....	....	40,306	86,399	....	83,230*g*	....	2,169	996	7,564	220,664
Metal workers	28,439	6,676	115	800	1,442	94,453	7,450	26,137	7,050	360	61,143	33,795	267,860
Woodworkers	10,530	....	....	23,820	34,946	12,413	....	153,000*h*	....	45,276	463,584	17,922	761,491
Food products	262,588	84,006	237,230	773,088	24,509	127,766	45,752	79,976	64,250	22,432	191,981	129,539	2,043,117
Flammable liquids and gases	36,811	4,973	1,917	....	....	10,174	6,204	....	2,500	....	22,085	4,704	89,368
Miscellaneous manufacturing	1,053,468	374,072	95,673	29,626	198,151	1,381,571	1,438,013	140,487	6,088	94,115	148,397	499,093	5,458,754
V. Miscellaneous Bldgs.													
Farm barns	....	551,681	978,490	....	....	299,098	1,689,517	73,677	96,043	....	72,154	989,010	4,749,670
Farm outbuildings	1,771,603	113,204	234,783	123,012	....	44,396	131,689	30,274	....	....	71,355	62,123	2,582,439
Lumber yards	38,099	29,176	192,241	2,327	4,117	149,524	249,377	....	....	....	2,180	20,700	687,741
Railroad, wharf property	20,805	9,495	65,327	266,025*i*	10,414*i*	29,245	37,816	9,539	170	....	86,302	....	535,138
Bulk oil storage	11,750	....	14,002	95,654*j*	258,586*j*	....	....	16,189*j*	....	....	....	....	396,181
Garages, filling stations	436,224	90,773	169,759	48,219	33,003	124,507	500,004	15,579	45,114	10,628	17,549	142,075	1,633,434
Miscellaneous buildings	365,505	41,948	366,670	78,341	137,035	677,202	1,109,789	58,385	3,710	72,220	82,101	180,338	3,173,244
Outdoor fires	430,083	32,764	71,400	26,792	168,073	61,431	84,942	62,335	14,264	....	11,075	158,959	1,122,118
Totals	$12,035,273	$5,047,632	$6,206,233	$4,358,823	$2,695,597	$10,251,288	$13,663,282	$3,224,343	$817,743	$1,508,115	$3,129,122	$5,890,245	$68,827,696

a. Includes restaurants.
b. Includes farm dwellings.
c. Includes apartments and garages.
d. Includes other farm property.
e. Includes combination stores and dwellings.
f. Includes warehouses.
g. Includes dry cleaners and laundries.
h. Includes lumber yards.
i. Includes light and power plants.
j. Includes filling stations and refineries.
*Fiscal year ending June 30, 1936.
†Insurance losses only.

Table III. Number of Fires by Causes in Twelve States — 1936.

Cause	Illinois	Indiana*	Iowa	Kansas	Louisiana	Massachusetts	Ohio	Oregon†	South Dakota*	Vermont	Washington†	Wisconsin	Totals
Chimneys, soot burning	....	....	1,657	....	....	324	2,037	....	....	....	143	1,862	6,023
Defective or overheated chimneys, flues	1,346	606	436	330	191	568	953	575	88	478	366	566	6,503
Sparks on roofs	3,234	463	....	562	292	....	....	387	....	34	303	....	5,275
Defective heaters	1,416	1,415	378	359	143	154	240	407	55	175	482	922	6,146
Rubbish near heaters	1,165	129	23	83	49	....	174	41	37	7	....	76	1,784
Combustibles near heaters	812	83	122	69	29	724	1,252	186	66	6	353	306	4,008
Open lights, flames	359	55	....	108	157	....	....	35	2	26	29	267	1,038
Hot ashes	306*a*	....	64	250	151	168	214	356	11	69	118	218	1,925
Oil burners	....	....	19	....	....	296	....	....	10	....	....	125	450
Careless smoking	2,464	224	394	309	584	2,155	1,672	1,282	54	310	1,040	1,770	12,258
Children with matches	....	....	103	....	....	440	430	....	27	....	58	207	1,265
Other careless use of matches	....	132	73	....	....	415	581	....	....	....	87	340	1,628
Defective electric wiring	1,726*b*	300	203	403*b*	246*b*	928*b*	1,540	235*b*	41	123*b*	261	1,012	7,018
Electric appliances and motors	....	75	101	....	....	....	165	....	7	....	196	415	959
Flammable liquids	985	70	72	160	243	527	714	88	5	149	172	278	3,536
Home dry cleaning	....	....	11	....	....	....	....	....	....	....	....	....	....
Starting fires	....	....	15	....	....	5	42	....	....	....	....	....	....
Lamps and stoves	....	146	329	....	....	66	197	....	55	....	30	511	1,334
Gas and appliances	165	21	17	24	63	20	113	....	5	2	....	131	561
Grease on stoves	149	....	37	34	54	113	140	207	1	33	183	175	1,126
Spontaneous ignition	559	128	254	114	24	442	614	68	22	34	109	305	2,673
Fireworks	65	3	45	19	19	123	....	17	....	13	6	38	348
Lightning	415	82	147	74	75	111	426	12	10	163	22	1,701	3,238
Thawing pipes	....	48	60	....	....	59	17	....	....	....	8	48	240
Sparks from machinery	15	10	7	33	111	28	23	54	2	4	68	26	381
Incendiary	92	54	29	39	43	156	354	24	10	10	53	51	915
Miscellaneous known causes	258	201	739	79	25	311	1,221	16	46	20	100	494	3,510
Suspicious	....	....	....	....	....	77	179	....	....	....	....	....	256
Unknown	2,074	835	882	1,030	703	343	3,042	422	113	295	580	739	11,058
Explosions	511	172	....	97	38	....	....	32	20	15	20	55	960
Exposure	1,457	128	334	332	351	219*c*	612	774	52	96	169	339	4,644
Totals	19,573	5,380	6,551	4,508	3,591	8,553	16,952	5,218	739	2,062	4,956	12,977	91,060

*Fiscal year ending June 30, 1936.
†Insurance losses only.

a. Includes open lights and flames.
b. Includes electric appliances and motors.

c. These fires are distributed according to causes above and therefore are indicated here but not added in again.

Table IV. Fire Loss by Causes in Twelve States — 1936.

Cause	Illinois	Indiana*	Iowa	Kansas	Louisiana	Massachusetts	Ohio	Oregon†	South Dakota*	Vermont	Washington†	Wisconsin	Totals
Chimneys, soot burning	....	....	$525,054	....	....	$142,947	$392,217	....	....	....	$38,386	$363,631	$1,462,235
Defective or overheated chimneys, flues	$707,250	$508,437	447,326	$286,862	$69,877	852,023	695,432	$208,728	$77,800	$189,310	225,006	469,996	4,738,047
Sparks on roofs	795,191	162,083	....	138,167	92,544	....	....	101,219	....	14,373	102,419	....	1,405,996
Defective heaters	724,570	810,944	215,810	249,001	33,999	214,459	89,051	106,232	25,787	56,081	278,240	490,966	3,295,140
Rubbish near heaters	157,156	43,055	2,995	13,302	6,111	....	47,070	2,591	9,367	1,342	....	14,897	297,886
Combustibles near heaters	117,213	20,942	38,092	26,256	32,108	646,623	727,127	11,918	23,493	5,173	60,444	186,575	1,895,964
Open lights, flames	116,044	18,712	....	22,686	29,307	....	....	7,433	198	4,688	2,099	13,522	214,689
Hot ashes	134,809*a*	....	36,903	39,363	64,950	122,829	95,612	42,160	1,588	6,692	11,393	16,926	573,225
Oil burners	....	....	10,016	....	....	240,812	....	....	1,454	....	....	24,728	277,010
Careless smoking	357,015	59,281	56,973	64,201	113,270	1,740,093	312,824	211,163	10,292	99,605	256,859	222,473	3,504,049
Children with matches	....	....	22,847	....	....	232,848	57,596	....	8,020	....	9,017	44,045	374,373
Other careless use of matches	....	46,541	45,383	....	....	238,667	101,147	....	....	....	9,902	29,156	470,796
Defective electric wiring	918,085*b*	388,714	373,184	191,765*b*	137,943*b*	1,359,272*b*	1,042,587	242,111*b*	52,569	65,664*b*	209,796	1,001,217	5,982,907
Electric appliances and motors	....	34,819	48,766	....	....	....	95,824	....	11,189	....	32,332	35,515	258,445
Flammable liquids	402,872	33,433	29,795	92,698	122,330	396,479	166,284	93,433	2,949	77,945	128,880	70,614	1,664,468
Home dry cleaning	....	....	1,573	....	....	....	....	....	....	....	....	....	....
Starting fires	....	....	18,519	....	....	568	26,096	....	....	....	....	....	....
Lamps and stoves	....	76,807	165,232	....	....	80,206	171,483	....	27,588	....	7,937	106,326	635,579
Gas and appliances	189,487	16,564	12,271	20,354	20,776	39,418	138,423	....	3,129	100	....	25,565	466,087
Grease on stoves	85,590	....	8,908	10,697	5,973	62,670	58,971	9,560	2,935	21,114	10,775	23,623	300,816
Spontaneous ignition	601,952	268,717	518,652	145,954	79,019	622,813	669,413	74,760	61,935	97,526	182,231	493,634	3,816,606
Fireworks	14,871	821	6,620	8,787	1,480	43,187	....	4,623	....	42,511	435	6,494	129,829
Lightning	678,786	128,636	238,889	539,235	21,386	152,797	453,896	5,495	14,049	81,880	7,008	345,987	2,668,044
Thawing pipes	....	11,474	24,460	....	....	25,407	8,071	....	....	....	1,370	21,829	92,611
Sparks from machinery	5,857	4,236	508	133,454	45,444	42,994	40,663	49,226	220	2,484	204,867	12,075	542,028
Incendiary	300,764	76,957	24,842	23,105	44,968	406,236	404,870	56,189	5,245	28,639	69,653	109,498	1,550,966
Miscellaneous known causes	112,035	50,402	315,244	52,858	7,264	257,385	538,832	4,510	17,938	6,889	43,006	158,843	1,565,206
Suspicious	....	....	....	....	....	167,555	249,614	....	....	....	....	....	417,169
Unknown	4,600,005	1,983,704	2,325,344	1,993,071	1,564,856	2,163,000	6,407,195	550,056	368,287	554,549	1,054,366	1,353,816	24,918,249
Explosions	174,562	192,315	....	173,207	38,654	....	....	15,292	17,099	34,021	122,402	20,383	787,935
Exposure	841,159	110,038	692,027	133,800	163,338	380,118*c*	672,984	1,427,644	74,612	117,529	60,299	227,911	4,521,341
Totals	$12,035,273	$5,047,632	$6,206,233	$4,358,823	$2,695,597	$10,251,288	$13,663,282	$3,224,343	$817,743	$1,508,115	$3,129,122	$5,890,245	$68,827,696

*Fiscal year ending June 30, 1936.
†Insurance losses only.

a. Includes open lights and flames.
b. Includes electric appliances and motors.
c. This loss is distributed according to causes above and therefore is indicated here but not added in again.

Table V. Fires and Losses by Occupancies in Five Provinces — 1936.

Occupancy	New Brunswick		Nova Scotia*		Ontario		Quebec		Saskatchewan		Totals	
	No. Fires	Loss	No. Fires	Loss	No. Fires	Loss	No. Fires	Loss	No. Fires	Loss	No. Fires	Loss
I. Public Buildings												
Government buildings	....	....	1	25	6	$889	27	$18,120	1	$100	35	$19,134
Hospitals and institutions	....	....	....	....	....	....	13	34,951	2	24,020	15	58,971
Schools	7*a*	$15,182*a*	18*a*	$19,476*a*	98*a*	181,120*a*	88	102,501	22	80,494	233	398,773
Churches	4	41,566	9	7,804	53	345,253	53	365,774	5	6,622	124	766,989
Amusement buildings	12	32,301	12	13,201	102	81,948	69	86,801	23	18,534	218	232,785
II. Dwelling Occupancies												
Hotels	16	2,502	10*b*	5,621*b*	216*b*	165,069*b*	220*b*	236,465*b*	24	33,098	486	442,755
Apartments	1	17	9	41,899	286	58,683	350	50,508	14	5,219	660	156,326
City dwellings	623	186,259	937*c*	410,598*c*	8,873	1,192,054	14,320*c*	2,321,626*c*	542*c*	268,492*c*	25,295	4,379,029
Farm dwellings	138	169,797	....	....	2,224	1,100,720	....	....	....	....	2,362	1,270,517
III. Mercantiles												
Office buildings	5	6,162	4	19,867	100	27,133	26	25,669	6	1,615	141	80,446
Small retail stores	63	148,196	80	418,549	1,206	1,541,884	958*d*	597,761*d*	89*d*	126,153*d*	2,396	2,832,543
Restaurants	....	....	....	....	....	....	71	55,928	11	5,812	82	61,740
Miscellaneous mercantiles	....	....	....	....	....	....	431	739,103	....	....	431	739,103
Storage warehouses	....	....	....	....	....	....	31	229,261	15	42,916	46	272,177
IV. Manufacturing												
Metal workers	4	46,194	....	....	....	....	34	23,629	1	265	39	70,088
Woodworkers	....	....	1	10	27	56,002	13	64,926	2	3,400	43	124,338
Food products	....	....	....	....	8	211,353	....	....	15	110,182	23	321,535
Miscellaneous manufacturing	9	167,053	35	199,209	478	1,385,540	158	636,974	5	23,692	685	2,412,498
V. Miscellaneous Bldgs.												
Farm barns	21	47,220	68	132,649	581	1,031,226	573	421,638	107	55,813	1,350	1,688,546
Farm outbuildings	....	....	20	6,529	....	....	58	44,239	41	8,106	119	58,874
Lumber yards	....	....	....	....	15	94,203	....	....	....	....	15	94,203
Railroad, wharf property	14	5,123	....	....	15	16,898	....	....	....	....	29	22,021
Garages, filling stations	12	9,689	21	10,184	207	134,448	77	52,289	28	31,680	345	238,290
Miscellaneous buildings	5	7,905	17	12,622	275	236,575	358	503,169	18	17,176	673	777,447
Outdoor fires	1	478	....	....	12	6,485	21	17,968	16	719	50	25,650
Totals	935	$885,644	1,242	$1,298,243	14,782	$7,867,483	17,949	$6,629,300	987	$864,108	35,895	$17,544,778

*Fiscal year ending Nov. 30, 1936.

a. Includes hospitals.

b. Includes lodging houses.

c. Includes farm dwellings.

d. Includes combination stores and dwellings.

Table VI. Fires and Losses by Causes in Five Provinces — 1936.

Cause	New Brunswick		Nova Scotia*		Ontario		Quebec		Saskatchewan		Totals	
	No. Fires	Loss	No. Fires	Loss	No. Fires	Loss	No. Fires	Loss	No. Fires	Loss	No. Fires	Loss
Chimneys, soot burning	....	....	....	....	....	....	....	....	41	$15,455	41	$15,455
Defective or overheated chimneys, flues	198	$130,727	168	$247,668	876	$274,909	1,790	$245,878	88	59,211	3,120	958,393
Sparks on roofs	77	44,427	268	44,427	....	....	155	60,362	....	....	500	149,216
Defective heaters	110	123,635	126	52,680	1,651	935,139	2,210	489,259	99	171,384	4,196	1,772,097
Rubbish near heaters	3	459	....	....	38	8,449	21	9,229	6	1,077	68	19,214
Combustibles near heaters	52	8,194	68	48,642	1,327	387,225	128	30,333	46	20,606	1,621	495,000
Open lights, flames	39	45,290	51	16,958	520	147,819	646	61,435	4	247	1,260	271,749
Hot ashes	16	1,752	27	5,947	285	28,327	1,192	110,070	34	57,143	1,554	203,239
Careless smoking	111	5,582	135	75,907	3,003	577,241	6,415	354,178	87	26,616	9,751	1,039,524
Children with matches	....	....	....	....	....	....	....	....	34	7,690	34	7,690
Other careless use of matches	41	5,696	44	2,567	846	133,428	....	....	7	806	938	142,497
Electric wiring, appliances	47	172,120	70	69,948	1,292	666,328	1,213	370,947	50	8,567	2,672	1,287,910
Flammable liquids	1	33	31	13,549	502	234,225	291	162,720	21	7,481	848	418,248
Home dry cleaning	....	....	....	....	....	....	....	....	1	160	....	....
Starting fires	....	....	....	....	....	....	....	....	1	81	....	....
Lamps and stoves	....	....	....	....	....	....	....	....	32	15,368	32	15,368
Gas and appliances	3	3,961	1	70	160	14,357	122	14,109	6	3,434	292	35,931
Grease on stoves	16	1,128	10	4,169	300	122,036	224	35,483	8	467	558	163,283
Spontaneous ignition	13	9,573	28	26,107	165	185,997	110	115,316	26	10,230	342	347,223
Fireworks	....	....	3	119	88	8,407	33	1,683	....	....	124	10,209
Lightning	43	8,135	28	20,176	607	302,868	243	75,997	46	16,373	967	423,549
Sparks from machinery	1	42	1	5,000	94	346,005	26	56,554	1	60	123	407,662
Incendiary	8	13,593	27	207,109	106	188,769	15	25,362	13	9,890	169	444,723
Miscellaneous known causes	34	42,019	19	12,108	126	25,270	234	39,748	52	18,735	465	137,880
Unknown	110	257,255	132	440,609	2,432	3,024,500	2,235	3,623,874	229	316,939	5,138	7,663,177
Explosions	11	11,987	2	173	143	144,361	147	111,014	1	1,234	304	268,769
Exposure	1	36	3	4,310	221	111,823	499	635,749	54	94,854	778	846,772
Totals	935	$885,644	1,242	$1,298,243	14,782	$7,867,483	17,949	$6,629,300	987	$864,108	35,895	$17,544,778

*Fiscal year ending Nov. 30, 1936.

The last three tables (VII, VIII and IX) consist of recapitulations and estimates for the entire United States and Canada based upon the first six tables and adding a certain percentage to cover unreported fires and losses as explained below. The many requests received by the N.F.P.A. for this information have for several years indicated the need for estimates as presented in

Table VII. Fires per 1000 Population and Fire Loss per Capita for the Twelve States and Five Provinces.

State	Population 1930 Census	Number of Fires	Fires per 1000 Population (1930 Census)	Fire Loss	Fire Loss per Capita (1930 Census)
Illinois	7,630,654	19,573	2.56	$12,035,273	$1.57
Indiana	3,238,503	5,380	1.66	5,047,632	1.55
Iowa	2,470,939	6,551	2.65	6,206,233	2.50
Kansas	1,880,999	4,508	2.40	4,358,823	2.32
Louisiana	2,101,593	3,591	1.70	2,695,597	1.28
Massachusetts	4,249,614	8,553	2.02	10,251,288	2.41
Ohio	6,646,697	16,952	2.55	13,663,282	2.06
Oregon	953,786	5,218	5.47	3,224,343	3.38
South Dakota	692,849	739	1.07	817,743	1.18
Vermont	359,611	2,062	5.73	1,508,115	4.20
Washington	1,563,396	4,956	3.17	3,129,122	2.00
Wisconsin	2,939,006	12,977	4.41	5,890,245	2.01
Total	34,727,647	91,060	2.62	$68,827,696	$1.98
Estimated U. S. Total	122,775,000	643,000	5.24	$303,700,000	$2.47
Province					
New Brunswick	435,000	935	2.15	$885,644	$2.03
Nova Scotia	537,000	1,242	2.31	1,298,243	2.41
Ontario	3,690,000	14,782	4.00	7,867,483	2.13
Quebec	3,096,000	17,949	5.80	6,629,300	2.14
Saskatchewan	931,000	987	1.06	864,108	.93
Total	8,689,000	35,895	4.13	$17,544,778	$2.02
Est'd. Canadian Total	11,014,000	57,000	5.17	$21,549,484*	$1.95*

*Data supplied by J. Grove Smith, Dominion Fire Commissioner. The loss figures by provinces above supplied by the fire marshals are substantially the same as those reported by the Dominion Fire Commissioner and published in the July, 1937, QUARTERLY.

Footnotes to Table VIII on opposite page:

*As indicated in Tables I and II only about half the states reported data on these occupancies, which makes these figures about half of what they should be. The figures shown were prepared on a uniform basis for consistency with other occupancy classes, but on the basis of the available data, doubling these figures will give a more accurate estimate.

†As indicated in Tables I and II only about half the states make clear distinctions between city and farm dwelling fires, and these figures, prepared on a uniform basis for consistency with other occupancy classes, do not give the correct distribution of fires and losses between urban and rural dwellings. On the basis of the available data it would appear that the distribution between the two classes may be approximately equal. On this basis the total of 362,200 dwelling fires with a loss of $103,200,000 is chargeable half to rural and half to urban areas, with 181,100 fires and $51,600,000 loss each. The same reasoning may be applied to the corresponding Canadian figures.

Table VIII. Estimated Distribution of Fire Losses by Occupancies — 1936.

These estimated figures are intended to show the relative order of magnitude of fire losses by occupancies, and while they are reasonable approximations based on the experience in typical states and provinces they should not be taken as exact records for each class.

Occupancy	United States		Canada	
	No. of Fires	Loss	No. of Fires	Loss
I. Public Buildings				
Government Buildings	500	$435,000	70	$23,500
Hospitals and Institutions	800	1,660,000	30	72,300
Schools	3,300	11,700,000	370	489,000
Churches	3,000	4,240,000	200	941,000
Amusement Buildings	4,200	4,420,000	350	285,000
II. Dwelling Occupancies				
Hotels	9,700	3,120,000	770	544,000
Lodging Houses	2,500*	872,000*	....	.....
Apartments	25,100*	5,900,000*	1,100	191,000
City Dwellings	333,900†	80,200,000†	40,200	5,370,000
Farm Dwellings	28,300†	23,000,000†	3,700	1,570,000
III. Manufacturing				
Office Buildings	2,600	1,120,000	220	99,000
Small Retail Stores	39,900	35,000,000	3,800	3,480,000
Restaurants	5,400	2,600,000	140	75,700
Miscellaneous Mercantiles	15,000	12,600,000	680	909,000
Storage Warehouses	6,000	12,100,000	80	334,000
IV. Manufacturing				
Textiles, Fabric Workers	1,300	976,000	....	.....
Metals Workers	1,400	1,180,000	60	86,000
Woodworkers	1,300	3,350,000	70	152,000
Food Products	3,800	9,020,000	40	394,000
Flammable Liquids and Gases	1,200	397,000	....	.....
Miscellaneous Manufacturing	10,800	24,100,000	1,080	2,970,000
V. Miscellaneous Buildings				
Farm Barns	19,500	21,000,000	2,100	2,070,000
Farm Outbuildings	25,900	11,400,000	180	72,000
Lumber Yards	800	3,030,000	30	116,000
Railroad, Wharf Property	1,600	2,360,000	50	27,000
Bulk Oil Storage	800*	1,760,000*	....	.....
Garages, Filling Stations	26,900	7,200,000	550	293,000
Miscellaneous Buildings	17,800	14,000,000	1,050	954,000
Outdoor Fires	49,700	4,960,000	80	31,500
Estimated Total	643,000	$303,700,000	57,000	$21,549,000

Note: As explained in the text, 100 per cent has been added in estimating the number of fires in the United States and 25 per cent in Canada; and 25 per cent has been added to the losses in the United States to cover unreported losses.

Footnotes to this Table are at bottom of opposite page.

Table IX. Estimated Distribution of Fire Losses by Causes — 1936.

These estimated figures are intended to show the relative order of magnitude of fire losses by causes, and while they are reasonable approximations based on the experience in typical states and provinces they should not be taken as exact records for each class.

Cause	United States		Canada	
	No. of Fires	Loss	No. of Fires	Loss
Chimneys, Soot Burning	42,600*	$6,500,000*	70	$19,000
Defective or Overheated Chimneys, Flues	46,000*	20,900,000*	5,000	1,170,000
Sparks on Roofs	37,200†	6,200,000†	800	184,000
Defective Heaters	43,300	14,500,000	6,600	2,180,000
Rubbish Near Heaters	12,500	1,330,000	110	23,000
Combustibles Near Heaters	28,200	8,350,000	2,600	610,000
Open Lights, Flames	7,300	950,000	2,000	330,000
Hot Ashes	13,600	2,530,000	2,400	250,000
Oil Burners	3,200†	1,220,000†	....	.....
Careless Smoking	86,700	15,500,000	15,500	1,270,000
Children with Matches	8,900	1,650,000	60	10,000
Other Careless Use of Matches	11,500	2,080,000	1,500	175,000
Defective Electric Wiring	49,500	26,400,000	4,300	1,580,000
Electric Appliances and Motors	6,800	1,140,000	....	.....
Flammable Liquids	25,000	7,300,000	1,340	515,000
Lamps and Stoves	9,400	2,800,000	50	19,000
Gas and Appliances	3,900	2,060,000	470	44,000
Grease on Stoves	8,000	1,320,000	880	200,000
Spontaneous Ignition	18,900	16,800,000	550	427,000
Fireworks	2,500	580,000	200	13,000
Lightning	22,900	11,700,000	1,550	520,000
Thawing Pipes	1,700	410,000	....	.....
Sparks from Machinery	2,700	2,400,000	200	500,000
Incendiary	6,500	6,850,000	270	550,000
Miscellaneous Known Causes	24,800	6,900,000	740	170,000
Suspicious	1,800‡	1,850,000‡	....	.....
Unknown	78,000	110,000,000	8,100	9,420,000
Explosions	6,800	3,480,000	480	330,000
Exposure	32,800	20,000,000	1,230	1,040,000
Estimated Total	643,000	$303,700,000	57,000	$21,549,000

NOTE: As explained in the text, 100 per cent has been added in estimating the number of fires in the United States and 25 per cent in Canada; and 25 per cent has been added to the losses in the United States to cover unreported losses.

*As indicated in Tables III and IV only about half the states make clear distinctions between these two causes. In the states that do not give separate figures for soot fires in chimneys, such figures are included in the second cause, Defective or Overheated Chimneys and Flues, and therefore these figures, prepared on a uniform basis for consistency with the other occupancy classes, do not give the correct distribution of fires and losses between the two causes. It appears reasonable, therefore, that about 50 per cent of the number of fires and losses should be subtracted from the Defective or Overheated Chimney class and added to the Soot Burning class. On this basis, the estimated number of Soot Burning fires would be 65,600 with a loss of $16,950,000, and the number of Defective or Overheated Chimney fires would be 23,000, with a loss of $10,450,000. The same reasoning may be applied to the corresponding Canadian figures.

†As indicated in Tables III and IV only about half the states use this class. It appears logical therefore that these figures should be doubled to obtain a more accurate approximation of the number of fires and amount of fire loss.

Tables VIII and IX. These are not accurate figures, but are the best estimates available as to the number of fires and the amount of the fire losses distributed by occupancies and causes.

Table VII is a recapitulation of the state and provincial totals presented in the foregoing tables with a column added to show the number of fires per thousand population and another column to show the fire loss per capita. With few exceptions the figures in these two columns are fairly uniform for the various states and provinces. It will be observed that a total of 91,060 fires were reported in 1936 for this group of twelve states having a total population of 34,727,647 in the 1930 U. S. census. From a study of the best data available it appears that this number of fires is approximately half the actual total number of fires for the year, and therefore 100 per cent has been added to this number to get the estimate for the twelve states. When the resulting figure is applied to the whole country at the 1930 population ratio, the estimated number of fires in the United States in 1936 is 643,000. This makes 5.24 fires per 1000 population (1930 census), as compared to a similar figure of 3.83 for 1935 (October, 1936, QUARTERLY, page 167). These figures were compiled on a somewhat different basis and may not be fully comparable, but it is clear that there has been a substantial increase in fires in 1936 as compared with 1935. Only 25 per cent was added to the number of fires reported in Canada because of the more complete reporting procedures employed in the provinces. On this basis the estimated numbers of fires in Canada and the United States are approximately in the same ratio as their populations.

The estimated total fire loss of $303,700,000 in the United States in 1936 was obtained by applying the population ratio to the total loss in the twelve states and adding 25 per cent for unreported losses, which appears to be a reasonable procedure. Fire marshals' reports are generally more accurate in respect to the amount of loss than in respect to the number of fires. The total fire loss figure of $21,549,484 for Canada is that reported by J. Grove Smith, Dominion Fire Commissioner.

Table VIII shows the total estimated number of fires and fire losses distributed by occupancies and based on the experience of the group of states and provinces listed in previous tables. Table IX shows similar figures by causes. Fire losses by causes are of limited significance, as other factors, such as building construction and public and private fire protection available, have a more direct bearing upon the resulting loss than does the cause of the fire. The number of fires by causes is a much better indication of the importance of a certain hazard or cause of fire. In these two tables a few of the figures are

‡As indicated in Tables III and IV only two states use this classification. Undoubtedly in the ten other states such fires are included in the Unknown and Incendiary classes, but to get a more accurate estimate of the seriousness of this class, the figures shown should be multiplied by six, making 10,800 fires, with a loss of $11,100,000.

missing for Canada because the reports did not contain sufficient data on those particular occupancies or causes. Such fires are included in other classifications, perhaps the miscellaneous classifications.

The occupancy and cause classifications appearing in all the tables are not listed in any order of importance, but are grouped so that similar classes come together. Also, each class is broad in scope in order to reduce the number of classes to a minimum and to permit the compilation of a sufficient amount of data on each to be of value. The best fire marshals' reports use many subdivisions of the general headings. For example, some reports use a class each for such as libraries, jails, city halls, etc., all of which were included under Government Buildings in this study. In the case of fire causes, the best reports used detailed classes, such as separating rodded buildings from those not rodded in case of fires caused by lightning, and dividing sparks on roofs into sparks on wooden shingle roofs and sparks on other roofing.

As has been previously emphasized, these fire experience figures are approximate, but give a fair indication of the distribution of losses by occupancy and by cause classifications and are the most reliable data available.

Cotton Warehouse Fire Record.

The total production of cotton in the United States during the 1935-36 season was 10,420,000 bales, or about 40 per cent of that produced in the whole world. The value represented by the 10,420,000 bales was approximately $600,000,000. The amount of cotton in United States warehouses in that season ranged from 8,600,000 bales in December, 1935, to 3,900,000 bales in August, 1936, or an average storage of 6,630,000 bales, according to the 1936 edition of the *Cotton Year Book* of the New York Stock Exchange. Cotton deteriorates when left in the open for any great length of time, and consequently the majority finds its way to warehouses for storage or shipment soon after being ginned. Cotton storage is a large and general business in the Southern States, almost every city and town having one or more storehouses.

Surfaces of cotton bales nearly always present a ragged appearance and when the bales are piled, tiered, or otherwise assembled in warehouses this loose surface material is readily susceptible to ignition, and the fire, once started, is likely to flash over the entire stock with extreme rapidity. Because of this high flammability of baled cotton and linters and their susceptibility to damage by smoke and water, as well as by fire, the N.F.P.A. Committee on Storage of Combustible Fibres prepared regulations many years ago, outlining the best methods of storing and handling cotton so as to afford the best protection against ignition and make reasonably certain that cotton warehouse

Causes of Fires.

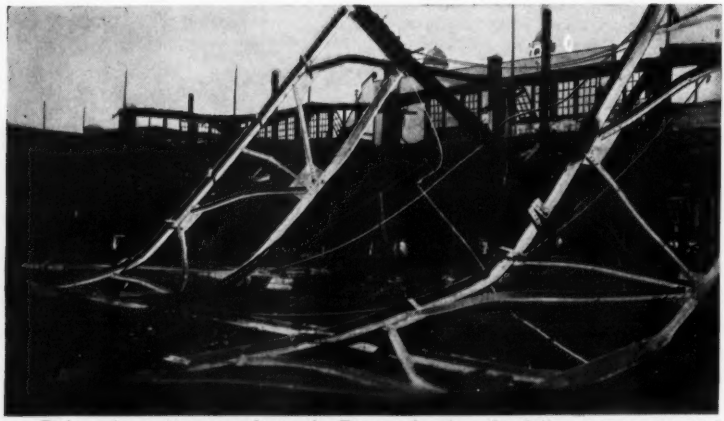
Cause	No. of Fires	Per Cent of Known Causes
Fire or spark left in bales from gin	48	25
Foreign material in stock	31	16
Spontaneous ignition	19	10
Smoking or matches	17	9
Electrical	16	8
Lightning	13	7
Incendiary	13	7
Exposure	9	5
Bales contacting or breaking light bulbs	5	3
Sparks from locomotives	2	1
Miscellaneous known causes	17	9
Total known causes	190	100
Unknown or not stated	156	
Total fires	346	

fires be quickly controlled and confined to the section where they originate.

The following record of 346 cotton warehouse fires reported to the N.F.P.A. Department of Fire Record during the 15-year period from 1922 to 1936 does not include all of the fires in this occupancy classification, but it is indicative of the general fire experience. The accompanying table shows the causes of 190 cotton warehouse fires for which this information was supplied.

Fire Packed Bales.

Fire or sparks left in the bales when they come to the warehouse from the gin is the greatest single cause of fires, having caused 25 per cent of the fires of known cause. This hazard is generally known as the "fire-packed" bale, and is undoubtedly responsible for a large proportion of the fires where the causes were not determined. Most fires in cotton gins originate from frictional sparks due to foreign material in the stock or static electricity; and often the fire is smothered by another gin-fall of cotton — leaving the smouldering lint to go through the gin box to result in a fire-packed bale. The next two leading causes of fires in cotton warehouses are associated with the fire-packed bale and can generally be traced to operations at the gin. Any fire in a cotton gin that is serious enough to result in a fire-packed bale is almost always self-evident to the gin attendant. While such small fires may be of small importance to the gin attendant, they are of considerable importance to the warehouseman who receives fire-packed bales. Apparently if gin operators would use extreme care and mark suspicious bales, or otherwise notify the warehouse agent, the latter could place them in a place where they would not endanger other cotton and where he could watch them. (See N.F.P.A. Proceedings for 1929, page 318.)



Ruins of a cotton warehouse in Texas, showing the failure of unprotected steel trusses. The fire lasted nearly five hours and caused fifteen wooden shingle roof fires on residences within a radius of ten blocks.

Construction of Cotton Warehouses.

Small cotton warehouses are usually one story in height, with brick side walls and wood roof. The larger ones are usually divided into sections by fire walls. The accompanying table indicates the general construction of the warehouses involved in this fire record. The regulations referred to above require cotton warehouses to be of fire-resistive construction throughout, arranged to

Construction of Warehouse	No. of Fires	Per Cent of Known Construction
Brick and Frame	129	49
Wood	65	25
Fire-resistive	37	14
Iron Clad	33	12
Total known construction	264	100
No data	82	
Total fires	346	

How Fires Were Discovered.

Discovered by	No. of Fires	Per Cent of Known Discovery
Employees	98	34
Watchmen	80	28
Outsiders	66	23
Sprinkler or automatic alarm	43	15
Total known discovery	287	100
No data	59	
Total fires	346	

limit the amount of cotton subject to destruction by a single fire, and equipped with proper fire extinguishing facilities, including automatic sprinklers.

Fire Loss Data.

In over fifty per cent of the 346 fires in this record for which loss figures were reported, the losses were less than $1000 per fire. However, in 25 fires the losses were over $100,000 each, as indicated by the accompanying table. Over $8,500,000 worth of buildings, equipment, and cotton was destroyed in the 89 fires involving losses of over $5000 each. More than 127,000 bales of cotton were destroyed by fire or damaged by fire and water in the 89 fires.

Loss	No. of Fires	Per Cent
Slight or less than $100	74	24.3
$100 to $999	89	29.1
$1,000 to $4,999	53	17.4
$5,000 to $9,999	21	6.9
$10,000 to $24,999	14	4.6
$25,000 to $100,000	29	9.5
Over $100,000	25	8.2
Total (where losses are known)	305	100.0
Unknown or not stated	41	
Total fires	346	

Eleven firemen lost their lives in four cotton warehouse fires covered in this record. Ten of these were killed by falling walls or floors, and the other one died from heart failure due to over excitement. Six of the firemen were killed in one fire, which occurred in Atlanta, Georgia, on May 6, 1925. The second floor, upon which the cotton was stored, collapsed and buried the men. Apparently the floor was overloaded and when the firemen arrived, the fire had already weakened some of the floor joists. With the additional weight of the water-soaked cotton the floor crashed. An automatic sprinkler system was being installed at the time of the fire, and had it been completed the six lives would no doubt have been spared.

Automatic Sprinkler Operation.

Seventy-five per cent, or 259, of the 346 fires included in this record were in sprinklered warehouses. In 17 cases the sprinklers were not a factor, leaving 242 fires in which they were a factor. The following table comparing the effect of sprinklers in cotton warehouse fires with sprinkler performance in all other classes of property indicates the severity of the cotton storage hazard. The efficiency of sprinkler performance in cotton warehouses is 90.9 per cent, as compared with 96.1 per cent in all classes of sprinklered property. This is also indicated in the table of number of sprinklers opened. Six or more sprinklers opened in 58.6 per cent of the cotton warehouse fires, as compared with

Twenty thousand bales of cotton stored in the streets of the business district in violation of city ordinances were destroyed in the $4,250,000 conflagration in Augusta, Georgia, on March 22, 1916. Among the 680 buildings destroyed were the two fire-resistive buildings shown gutted above. The cotton obstructed the path of fire apparatus, interfered with access to hydrants, and furnished fuel for the rapid spread of the fire. Cotton is a serious enough fire hazard in warehouses.

25.2 per cent in fires in all other classes of sprinklered property. Considering the high flammability of cotton, sprinklers are highly efficient in cotton warehouses.

A typical example of the effect of a closed sprinkler control valve occurred in Atlanta, on Nov. 14, 1931. The warehouse was a one-story brick joisted building with composition roof and concrete floors. Fire was brought into the warehouse inside a bale of cotton which had been freshly ginned the day

Tables Showing Sprinkler Performance.

Effect of Sprinklers	Cotton Warehouse Fires No. of Fires	Per Cent	All Classes of Sprinklered Property No. of Fires	Per Cent
Extinguished fire	144	59.5	41,382	70.1
Held fire in check	76	31.4	15,558	26.0
Total satisfactory control	220	90.9	57,440	96.1
Unsatisfactory	22	9.1	2,342	3.9
Total (sprinklers operating)	242	100.0	59,782	100.0
Sprinklers not a factor	17			
Total	259			

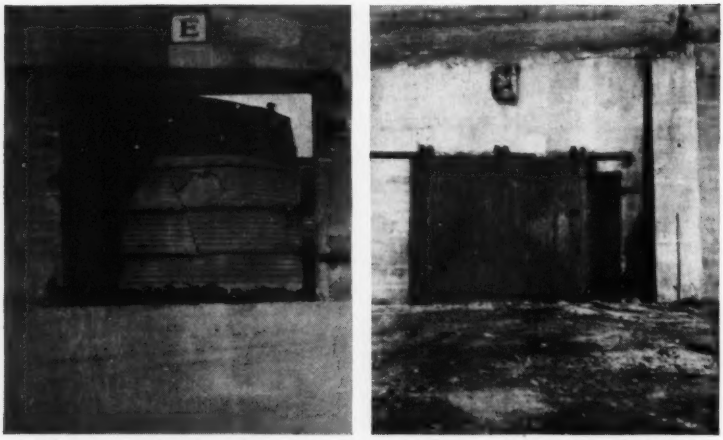
Number of Sprinklers Opened.

No. of Sprinkler Heads Opening	Cotton Warehouse Fires Number	Per Cent	All Classes of Property Per Cent
1	31	13.4	35.0
2	26	11.2	17.4
3	14	6.0	9.5
4	15	6.5	6.7
5	10	4.3	4.1
6 to 9	31	13.4	9.5
10 to 25	50	21.5	9.7
26 to 50	22	9.5	3.0
Over 50	33	14.2	3.0
Total (data available)	232	100.0	97.9
No data	10		2.1*
Total fires	242		100.0

*Includes one-tenth of one per cent open head systems.

Reasons for Unsatisfactory Operation of Sprinklers.

	No. of Fires
Control valve closed or practically closed	3
Use of hose streams robbed sprinklers of water	3
Obstructions in sprinkler piping	3
High piling of bales obstructed distribution of water	2
Obstruction in dry pipe valve prevented valve from tripping	2
Fire outside city, and fire department delayed; weak water supply	1
Inadequate water supply, city standpipe had been drained for cleaning	1
Quick spread of fire opened many heads and overtaxed water supply	1
Slow operation of tripping mechanism in dry pipe valve	1
Slow or poor operation of system; pipe fell from ceiling	1
Watchman shut off sprinklers without investigating fire	1
Roof fell shortly after lightning struck, breaking pipes	1
Metal doors between compartments left open, wind took heat from sprinklers	1
Reason not given	1
Total unsatisfactory fires	22



Fire doors in division walls after a fire in a three section cotton warehouse in Galveston, Texas, on October 11, 1931. The one at the left shows the effect of the heat, but apparently helped to check the fire, and the one at the right was found open as shown after the fire. Cotton was tiered almost to the roof from wall to wall, with little clearance around the doors. The fire, caused by a fire-packed bale, spread rapidly and burned 12,550 bales, with a total property loss of $350,000.

before. All of the 51 heads in this one compartment and nine heads under the adjoining shed fused, but no water discharged because the valve controlling them was closed. The fire department extinguished the fire with hose streams. About 450 bales in the compartment were burned and wet down, and about 150 bales in another compartment were destroyed by smoke and water. (S-59673.)

An example of hose streams robbing sprinklers of water occurred in Columbia, South Carolina, on September 29, 1930. The cotton was tiered four bales high and the compartment was filled to capacity. The lower bales being out of reach of water from the sprinklers permitted the fire to spread through them. Although one gate valve in a city connection was closed, there was sufficient water available through another connection to operate 50 heads. With this and the gravity tank there would have been enough water to supply all the heads involved, but when the fire department operated hose streams (as many as eleven at one time), the sprinklers didn't receive sufficient water, even though they did do some good on the topmost bales. Nearly all of the 1600 bales stored in the sections involved were damaged to the extent of $15,000 and $1500 loss to the warehouse. (S-58419.)

Another example of high piling of bales combined with obstructions in the sprinkler piping occurred in Kannapolis, North Carolina, on April 12, 1934. About 2000 bales of cotton were piled seven and eight high on their sides.

Fire of unknown origin opened 61 heads, but they failed to control the fire because five lines of sprinklers were found to be plugged with foreign material at the reducing fittings. The roof was badly burned and part of the piping where the sprinklers did not operate fell down. (S-68596.)

Analyzing the losses per fire in the 89 fires in this record which caused $5000 or more damage, the value of automatic sprinkler equipments in cotton warehouses is clearly demonstrated. The following table shows an average loss per fire of $138,000 in unsprinklered warehouses, as against $11,600 in warehouse fires where sprinklers did a satisfactory job, and $47,800 where sprinklers did not operate satisfactorily.

Losses in Fires Over $5000.

	No. of Fires	Loss in Dollars	Loss per Fire
Sprinklered property, satisfactorily extinguished	20	$233,327	$11,600
Sprinklered property, unsatisfactory operation	14	671,621	47,800
Unsprinklered property	55	7,604,049	138,000
Total	89	$8,508,997	$95,800

The fire record shows that high piling of cotton bales is a serious matter because sprinklers cannot reach the seat of the fire and such a fire generally opens sprinklers over a considerable area. This often makes it necessary to use hose streams, but their effectiveness is also restricted by the high piling. Arrangement of the piles in regard to size, stability, and aisle spaces are other important considerations affecting the loss in event of fire. It is generally considered best practice to avoid tiering or piling and to divide the stock into relatively small units with the bales on end and not tiered. Where tiering is employed, sprinkler protection can be made reasonably effective if one end of every bale faces an aisleway five feet or more in width, but for such warehouses the water supplies should be well above the average as to volume and pressure.

Fires in Which There Was Loss of Life.

Third Quarter, 1937.

Since the publication of the July QUARTERLY, the N.F.P.A. Department of Fire Record has received from various sources 126 reports of fires in which there was loss of life. A total of 227 lives was lost in these fires. During the period the following fires were reported in the United States and Canada, which caused the loss of more than five lives each.

JULY 2, 1937, NAMPA, IDAHO. Four women and two children were killed when the retail fireworks stock of a drug store was ignited supposedly by a careless child with a piece of "punk." (See page 110.) (H-41868.)

JULY 15, 1937, SULLIVAN, IND. An explosion in a coal mine hurled many miners against shaft walls and ceilings, fatally injuring 18. The source from which the gas was ignited was not determined. (H-41867.)

JULY 23, 1937, UPPER MARLBORO, MD. One man, four women, and two children were fatally burned in an automobile accident. A man driving a small sedan stopped on a highway too quickly for a following truck and semi-trailer to avoid smashing into its rear. At the impact, the fuel tank split, showering the occupants of the pleasure car with gasoline, which was instantly ignited. The truck careened crazily for a hundred feet, toppled off the left-hand shoulder of the road, and overturned, but did not catch fire. Its driver was the sole survivor of the crash. (H-41866.)

AUGUST 3, 1937, RAND, COLO. Six persons, a woman, two men, and three children, were burned to death in a fire that trapped them in a small rural cabin. (L-4037.)

Pictures, Inc.

In this spectacular fire that destroyed four automobiles and their transport truck on the left and the light coupé on the right, the driver of the coupé was burned to death. The accident occurred on August 4, 1937, near Akron, Ohio. (H-41879.)

Loss of Life Fires, July-September, 1937.

This is a typical rather than a complete record, presented to show the conditions under which loss of life occurs, that they may be known and guarded against. The total loss of life by fire in the United States is estimated at 10,000 annually.

Class of Fire	Fires	Men	Women	Children	No Data	Total
Airplane fires	7	11	2	0	0	13
Apartments, hotels, tenements, etc.	13	11	4	0	2	17
Auditorium	1	1	0	0	0	1
Automobiles, buses, trucks	12	14	9	2	0	25
Gasoline tank trucks	1	1	0	0	0	1
Barns and stables	3	2	0	1	0	3
Boats and ships	5	7	0	3	0	10
Conflagrations	1	0	0	0	2	2
Dwellings—Rural	22	5	17	14	0	36
Dwellings—Urban	22	7	11	11	0	29
Forest or brush fires	3	18	0	0	0	18
Garages	2	2	0	0	0	2
Hospitals	1	0	0	1	0	1
Institutions	2	1	1	0	0	2
Manufacturing occupancies, misc.	8	18	0	0	0	18
Mercantile occupancies, misc.	3	2	4	2	0	8
Mining property	3	20	0	0	0	20
Oil refineries	1	1	0	0	0	1
Oil wells	2	4	0	0	0	4
Out of doors	10	2	0	8	0	10
Railroad rolling stock	2	4	0	0	0	4
Tents	1	0	0	1	0	1
Underground tunnel	1	1	0	0	0	1
Totals	126	132	48	43	4	227

AUGUST 20, 1937, CODY, WYO. In the Shoshone National Forest along Blackwater Creek a forest fire that burned 1100 acres caused the death of fifteen fire fighters. They were trapped when a high wind arose, and the creeping fire which they had been fighting "climbed the trees and exploded." (H-41865.)

AUGUST 24, 1937, BALDWIN, N. C. In an aluminum company plant the explosion of an oil switch caused the death of seven employees who were repairing a transformer. (H-41864.)

Several outstanding loss of life fires outside the United States and Canada have been reported for this quarter. While these are not included in the tables they are of sufficient interest to warrant brief mention here.

JULY 2, 1937, CHESTERTON, STOKE-ON-KENT, ENGLAND. Twenty-two miners were reported killed in two explosions at a coal mine.

JULY 6, 1936, HIROSHIMA, JAPAN. Barred from escape by iron grillwork on the windows of a private sanitarium, twenty-one patients were killed when the building burned down.

JULY 18, 1937, CHUNKING, CHINA. Japanese newspapers reported that 300 Chinese girl workers were killed in the explosion of a plant where munitions "for war against Japan" were being manufactured.

JULY 28, 1937, BRUSSELS, BELGIUM. A transport plane crashed in a potato field near Brussels and in the crash and fire that followed, the 15 occupants of the plane lost their lives.

AUGUST 23, 1937, UNTERLUSS, GERMANY. Two explosions in a powder magazine killed twelve firemen and injured 67 workers.

Causes of Loss of Life, July-September, 1937.

Fatalities classified according to the immediate cause of the loss of life rather than according to the cause of the fire.

Airplane fires	11	2	0	0	13
Automobile, bus and truck fires	14	9	2	0	25
Tank truck fires	1	0	0	0	1
Boat and ship fires	7	0	3	0	10
Children playing with matches	0	0	9	0	9
Clothing ignited:					
Bed clothes ignited from sun lamp	0	0	1	0	1
Bonfire	0	0	2	0	2
Fireplace	0	1	0	0	1
Fireworks	0	0	1	0	1
Furnace, stove, or heater	0	3	1	0	4
Smoking	2	1	0	0	3
Miscellaneous or unknown	1	1	0	0	2
Conflagrations	0	0	0	2	2
Entering or re-entering burning buildings	1	0	0	0	1
Escaping fires — jumped	1	0	0	0	1
Explosions (miscellaneous):					
Blasting powder	5	0	0	0	5
City gas	2	0	0	0	2
Drying oven	2	0	0	0	2
Fireworks	1	4	2	0	7
Sewer gas	0	0	1	0	1
Miscellaneous or unknown	2	0	0	0	2
Fire fighting, firemen	3	0	0	0	3
Flammable liquids and vapors:					
Alcohol fires and explosions	2	0	0	0	2
Coal tar explosion	1	0	0	0	1
Gasoline stove explosion	0	2	0	0	2
Heating turpentine on stove	0	1	0	0	1
Home dry cleaning	0	2	0	0	2
Oil refinery	1	0	0	0	1
Oil stove, furnace or lamp	0	1	0	0	1
Oil transformer explosion	7	0	0	0	7
Oil well	4	0	0	0	4
Starting fires with gasoline	0	3	3	0	6
Starting fires with kerosene	0	2	0	0	2
Welding "empty" gasoline tank	1	0	0	0	1
Miscellaneous cleaning with gasoline	1	0	1	0	2
Miscellaneous gasoline explosions	2	1	1	0	4
Miscellaneous kerosene explosions	0	1	0	0	1
Forest or brush fires (including fire fighting)	18	0	0	0	18
Mine fires and explosions	20	0	0	0	20
Overcome by smoke, suffocation	1	0	1	0	2
Railroad rolling stock	4	0	0	0	4
Shock at fire	1	0	0	0	1
Traffic accidents at fires	1	0	1	0	2
Trapped in burning buildings	15	14	14	1	44
Trapped in incendiary fire	0	0	0	1	1
Totals	132	48	43	4	227

International.

On April 29, 1937, in Gardena, California, this truck and trailer unit and Pacific Electric mail train crashed. The driver of the gasoline transport was fatally burned. Note charred telegraph pole. (H-41880.)

Typical Loss of Life Fires.

Alcohol Fire.

APRIL 19, 1937, ST. LOUIS, MO. A janitor, washing windows, stood on a ladder directly above a 300-gallon tank of grain alcohol. For an unexplained reason he fell into the tank, splashing alcohol in all directions. It was ignited by an automobile engine, and the janitor was fatally burned. (L-4038.)

Boat and Ship Fires.

JULY 18, 1937, WASHINGTON, D. C. Caught in a fire aboard a motor boat on the Potomac River, the one occupant, who could not swim, was drowned when the heat forced him to jump overboard. The fire was started when a gasoline tank exploded. (H-41869.)

SEPTEMBER 5, 1937, SAN PEDRO, CAL. An explosion set fire to a large gasoline motor-yacht at sea off San Pedro. Three children were trapped in the cabin near the bow and burned to death. (H-41871.)

Children Playing with Matches.

JULY 26, 1937, CHARLESTON, MO. A three-year-old girl was setting fire to some rags in her back yard when her clothing was ignited and she was burned to death. (L-4039.)

AUGUST 10, 1937, GRAND ISLAND, NEB. A five-year-old boy playing with matches set fire to a can of distillate oil. The can exploded and the boy was burned to death by the sheet of flame. (L-4040.)

Clothing Ignited.

JULY 20, 1937, BUNCETON, MO. A mother and her daughter were bottling jelly and sealing it with melted paraffin. The mother was burned to death when the paraffin ignited and the fire spread to her clothing. (L-4042.)

JULY 30, 1937, FREDERICK, MD. A woman was lighting a gas stove. when her kimono ignited and she was burned to death. (L-4043.)

A gardener was trapped in the upstairs rooms of this garage and stable and burned to death when it caught fire on August 23, 1937. The building is located in a residential district of Boston, Mass. (H-41863.)

SEPTEMBER 7, 1937, WILMINGTON, DEL. A six-weeks-old baby in a hospital crib was burned to death when a sun lamp used medicinally fell among the bed clothes and ignited them. (H-41873.)

Escaping Fire — Jumped.

JUNE 26, 1937, FRESNO, CAL. A man 65 years old was fatally injured when he jumped from the second-story window of a burning hotel and landed on his head. (H-41874.)

Fireworks.

MAY 11, 1937, ST. LOUIS, MO. An employee of a powder manufacturing plant was fatally injured when several small torpedoes that he was breaking into molds exploded in his hands. The explosion blew both his hands completely off. (H-41875.)

Gasoline Stove Explosion.

JUNE 24, 1937, SANGER, CAL. A woman was fatally burned when the gasoline stove in her rural dwelling exploded. The house was destroyed in the fire that followed. (L-4046.)

Gasoline Insecticide.

JUNE 24, 1937, COUNCIL BLUFFS, IOWA. A boy nine years old poured gasoline on a grasshopper and set fire to it. The grasshopper sprang on the boy's clothing, which was likewise saturated with gasoline, and both died in the fire. (L-4047.)

Welding "Empty" Gasoline Tanks.

MAY 21, 1937, BIGGERS, ARK. A man was killed when an "empty" gasoline tank on which he was using a blow torch exploded. (H-41878.)